

**GEOTECHNICAL DESIGN REPORT  
PART 1 GEOTECHNICAL INVESTIGATION  
BATTLESHIP TEXAS DRY BERTH  
TPWD PROJECT NO. 101887**

**SUBMITTED TO  
AECOM  
5757 WOODWAY DRIVE, SUITE 101 WEST  
HOUSTON, TEXAS 77057**

**BY  
HVJ ASSOCIATES, INC.  
HOUSTON, TEXAS  
AUGUST 22, 2011**

**REPORT NO. HG1015021-2**



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August 22, 2011

Mr. Jerry Farhat, PE  
AECOM  
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Houston, Texas 77057

Re: Geotechnical Design Report  
Part 1 Geotechnical Investigation  
Battleship Texas Dry Berth  
TPWD Project No. 101887  
Owner: Texas Parks and Wildlife  
HVJ Report No. HG1015021-2

Dear Mr. Farhat:

Submitted herein is the engineering report of our Part I geotechnical investigation for the above referenced project. The study was performed in accordance with our proposal number HG1015021 dated September 21, 2010.

It has been a pleasure working for you on this project and we appreciate the opportunity to be of service. Please notify us if there are questions or if we may be of further assistance.

Sincerely,

**HVJ ASSOCIATES, INC.**

Texas Firm Registration No. F-000646

A handwritten signature in blue ink, appearing to read 'Michael Hasen', is written over a light blue horizontal line.

Michael Hasen, PE  
Executive Vice President

MH/SV/ZA:abm

Copies submitted: 1 (electronic)

The seal appearing on this document was authorized by Michael Hasen, PE 57498 on August 19, 2011. Alteration of a sealed document without proper notification to the responsible engineer is an offense under the Texas Engineering Practice Act.



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## 1. EXECUTIVE SUMMARY

HVJ Associates, Inc. was retained by AECOM to provide a geotechnical investigation for the dry berth of Battleship Texas in Houston, Texas. The project will involve conversion of the existing berth from wet to dry. The ship will be supported on deep foundations beneath the keel. The investigation will be performed in two parts. This report presents Part 1 of our study which is intended to provide the information needed to support preliminary design and cost estimates for the evaluation of a recommended alternative. Part 2 is intended to provide additional investigation needed to support detailed design of the selected alternative, and will be provided later.

The subsurface stratigraphy at the project site was determined by drilling and sampling one 300-foot boring and two 120-foot borings on land; and three 150-foot borings in water. The subsurface soils generally comprise of very soft to hard fat clays, sandy lean clays and lean clays to the termination depth of the borings. Loose to very dense sand layers generally about 5 feet thick were encountered at variable elevations in the borings. Two piezometers were installed to monitor groundwater elevation behind the slope which ranged between +0.74 feet and +1.47 feet. Details of the field and laboratory investigation are presented in the Part 1 Geotechnical Data Report submitted separately.

Four alternative designs were developed for the Part 1 study. We wish to point out that for several of the berth layouts a substantial portion of the footprint is outside of the area explored by borings for the Part 1 study. These analyses should be considered preliminary until a boring program that fully encompasses the facilities for the selected alternative is performed in Part 2. Based on the engineering analyses performed for this study, the findings and recommendations for each alternate are summarized below:

- 1 Ship Foundation – The ship keel blocks for all 4 alternatives may be designed based on drilled shaft foundations. For 36-inch diameter drilled shafts the required tip penetration for 200, 250, and 300 ton allowable capacities are 90, 105, and 120 feet, respectively. Note that if sand layers are encountered when installing driven piles installation to design penetration may not be possible without special measures.
- 2 Alternate 1.2.1 – Berth located at about the current location with top of slab @ El. -26 constructed with sloping sides and cantilever king pile walls. Geotechnical results:
  - a. Berth Side Slopes: 3H:1V from top of berm at El. +13 to base of berth at El. -26.
  - b. King Pile: Pile system with moment of inertia (I) of 11,000 in<sup>4</sup>/foot, 110 feet long is suitable, predicted top of wall movement under full 100-year surge load is 8.9 inches with a maximum moment of 1066.7 ft-kip/ft. Top of wall is at El. +13 feet.
  - c. Seepage: Estimated seepage is 20 gallons/day/linear foot for the slope. The volume of seepage through the soil around the king pile wall will be negligible; seepage volume along the wall will be controlled by seepage through the wall structure.
- 3 Alternate 1.3 – Berth located at about the current location with top of slab @ El. -38 constructed with sloping sides and cantilever king pile walls. Geotechnical results:
  - a. Berth Side Slopes: 4H:1V from top of berm at El. +13 to base of berth at El. -38.
  - b. King Pile: Pile system with I of 11,000 in<sup>4</sup>/foot, 110 feet deep is suitable, predicted top of wall movement under full 100-year surge load is 12.4 inches with a maximum moment of 1266.7 ft-kip/ft. Top of wall is at El. +13 feet.
  - c. Seepage: Estimated seepage is 20 gallons/day/linear foot for the slope. The volume of seepage through the soil around the king pile wall will be negligible; seepage volume along the wall will be controlled by seepage through the wall structure.
- 4 Alternate 2.2B – Berth located north of the current location with top of slab @ El. -38 constructed with sloping sides and cantilever king pile walls. Geotechnical results:

- a. Berth Side Slopes: 4H:1V from top of berm at El. +13 to base of berth at El. -38.
  - b. King Pile: Pile system with I of 11,000 in<sup>4</sup>/foot, 110 feet deep is suitable, predicted top of wall movement under full 100-year surge load is 9.8 inches with a maximum moment of 1183.3 ft-kip/ft. Top of wall is at El. +13 feet.
  - c. Seepage: Estimated seepage is 20 gallons/day/linear foot for the slope. The volume of seepage through the soil around the king pile wall will be negligible; seepage volume along the wall will be controlled by seepage through the wall structure.
- 5 Alternate 3.0 – Berth located northeast of the current location with top of slab @ El. -38 constructed with tieback slurry wall and cantilever king pile walls. Geotechnical results:
- a. Tieback Slurry Wall: Pile system with I of 9444.4 in<sup>4</sup>/foot, 80 feet deep with 3 levels of tiebacks is suitable, maximum wall movement under full 100-year surge load is 1.1 inches at 33 feet below top of wall with a maximum moment of 116.7 ft-kip/ft. Tieback system comprises 12-inch diameter tiebacks about 125 feet long installed at an inclination of 2H:1V at 10, 25, and 38 feet below top of wall. Top of wall is at El. +14 feet.
  - b. King Pile: Pile system with I of 16,000 in<sup>4</sup>/foot, 125 feet deep is suitable, predicted top of wall movement under full 100-year surge load is 19.4 inches with a maximum moment of 2133.3 ft-kip/ft. Top of wall is at El. +13 feet.
  - c. The volume of seepage through the soil around the king pile and slurry walls will be negligible; seepage volume will be controlled by seepage through the wall structure.

Please note that this executive summary does not fully relate our findings and opinions. These findings and opinions are only presented through our full report.

## **2. INTRODUCTION**

### **2.1 Project Description**

HVJ Associates, Inc. was retained by AECOM to provide a geotechnical investigation for the dry berth of Battleship Texas in Houston, Texas. The project will involve conversion of the existing berth from wet to dry. The ship will be supported on deep foundations beneath the keel. The investigation will be performed in two parts. Part 1 of our study is intended to provide the information needed to support preliminary design and cost estimates for the evaluation of a recommended design. This report is part of the Part 1 study. Part 2 is intended to provide additional investigation needed to support detailed design of the selected alternative.

### **2.2 Scope of Work**

The primary objectives of this study were to develop design and construction recommendations for the proposed battleship dry berth foundation. The objectives were accomplished by:

1. Drilling one 300-foot boring and two 120-foot borings on land; and three 150-foot borings in water to determine soil stratigraphy and to obtain samples for laboratory testing;
2. Obtaining four surface sediment samples within the slip for environmental analysis;
3. Installing two piezometers to monitor water levels adjacent to the slip and performing a slug test to assess the in situ hydraulic conductivity of the formation;
4. Performing laboratory tests to determine physical and engineering characteristics of the soils;
5. Performing engineering analyses to develop design guidelines and recommendations.

The field and laboratory investigations were described in detail in the Part 1 Geotechnical Data Report dated February 25, 2011. That report contains descriptions of the field exploration, laboratory-testing program, and general subsurface conditions. Design recommendations and construction considerations are presented in this report.

## **3. SITE CHARACTERIZATION**

### **3.1 Geotechnical Borings**

The subsurface stratigraphy at the project site was determined by drilling and sampling one 300-foot boring and two 120-foot borings on land; and three 150-foot borings in water. The borings were drilled at the approximate locations indicated on the plan of borings, Plate 2. The land borings were drilled using an all terrain mounted drilling equipment using dry and wet auger techniques. The water borings were drilled using a jack up barge. The boring logs and a key to the soil classification and symbols are included in Appendix A.

### **3.2 General Geology**

There are two major surface geological formations that exist in the Houston area: the Beaumont formation and the Lissie formation. The Beaumont formation is a relatively younger formation generally found to the southeast of the Lissie formation. The Beaumont formation dips

southeastward and extends beneath beach sand and waters of the Gulf of Mexico as far as the continental shelf. The project site is located in the Beaumont formation.

The Beaumont formation was deposited on land near sea level in flat river deltas and in inter-delta regions. Soil deposition occurred in fresh water streams and in flood plains (as backwater marsh and natural levees). The courses of major streams and deltaic tributaries changed frequently during the period of deposition, generating within the Beaumont clay a complex stratification of sand, silt and clay deposits. Frequently, stream courses were diverted significant distances from a given point in a backwater marsh, and the water overlying the soil would evaporate since it was cut off from a drainage path. Such water which would be highly alkaline would precipitate large nodules of calcium carbonate (calcareous nodules) throughout the surface of evaporation. With the coming of the Second Wisconsin Ice Age, the nearby sea withdrew, leaving the formation several hundred feet above sea level and permitting the soil to desiccate. The process of desiccation compressed the clays in the formation such that they became significantly overconsolidated to a large depth. In addition to preconsolidating the soil, the process of desiccation, together with the later rewetting, produced a network of fissures and slickensides that are now closed but which represent potential planes of weakness in the soil.

### 3.3 Geologic Faulting

The tectonic history of the Texas Gulf Coast includes a relatively stable depositional cycle since the Cretaceous Period (about 65 million years). During this period the area has been subjected to deposition of clays, silts, and sands resulting in over 30 thousand feet of sedimentary rocks. Underlying this clastic sequence are salt formations, which have migrated upwards to produce the typical salt dome features associated with the Texas Gulf Coast. In conjunction with salt movement, dewatering and compaction of some of the deeper sediments in the basin have resulted in the development of growth faults.

A review of surface faults was made from geologic literature and available in-house records. The primary objective of this review was to evaluate available information from these reports concerning the presence of active faults in the project area. Based on our review, Deepwater fault is located at about 4 miles southwest of the project site, Battlegrounds fault is located about 2 miles southeast of the project site, and Wooster fault is located about 3 miles northeast of the project site. We do not anticipate faulting may impact the project site. However, it should be noted that unmapped faults that could impact the project may exist within the project area. A detailed fault study is beyond the scope of this study.

### 3.4 Soil Stratigraphy

Our interpretation of soil and water conditions along the project alignment is based on information obtained at the boring locations only. This information has been used as the basis for our conclusions and recommendations. Significant variations at areas not explored by the project borings may require reevaluation of our findings and conclusions.

The subsurface soils generally comprise of very soft to hard fat clays, sandy lean clays and lean clays to the termination depth of the borings. Subsurface profiles showing conditions at the site are shown in Plates 3A and 3B. Loose to very dense cohesionless clayey sands, silty sands, sandy silts and silts were encountered between elevations -6 feet and -11 feet in boring B-1; between elevations -4 feet and -9 feet, and between elevations -69 feet and -74 feet in boring B-2; between elevations -212 feet and -238 feet, and below elevation -283 feet in boring B-3; between elevations -64 feet and -74 feet, between elevations -84.5 feet to -89.5 feet and between elevations -134.5 feet and -139.5 feet in boring B-4. Fill material comprising of fat clay and sandy lean clay with shells and rocks was encountered between elevations +11 feet and -1 feet at boring locations B-1 and B-3. Ferrous and calcareous nodules were encountered at various depths in all the borings.



### 3.5 Ground Water

Groundwater was encountered at elevations ranging between -4 feet and 0 feet during the drilling operations. Two 40-foot piezometers were installed to monitor groundwater elevation behind the slope. Water level readings in the piezometers ranged between +0.74 feet and +1.47 feet.

## 4. GEOTECHNICAL ENGINEERING ANALYSES

A substantial amount of geotechnical engineering analysis was performed for the alternatives analysis. This report presents the results of the geotechnical analyses for the final four alternatives evaluated for Part 1. Other analyses were performed for concepts that were not considered attractive enough to be included as part of a recommended alternative. Those analyses are not summarized in this report. This section of the report discusses the analysis procedures used during the Part 1 geotechnical design.

### 4.1 Keel Block Foundations

Capacity analysis was performed using the computer program SHAFT developed by Ensoft for drilled shaft foundations. We assumed drilling will require the use of drilling mud during drilled shaft construction. Skin friction in clays was based on an alpha value of 0.55. Skin friction in sand was based on calculating the friction between the pier and soil based on the friction angle and overburden pressure of the soil.

The upper ten feet below lowest final adjacent grade was neglected to allow for disturbance due to the presence of subsurface utilities, other adjacent excavation, and shrink-swell potential of the site. The calculations are based on Boring B-5 which is located near the center of the existing berth. We have analyzed 24-inch square driven precast concrete piles and 36-inch diameter drilled shafts. The results of the calculations are shown on Plate 4. Since the keel block foundation capacity analysis is common to all four alternatives we present the results in this section.

Drilled shafts can be extended to long lengths with the main constructability constraint being the ability to handle a long reinforcement cage. Drilled shafts 80 to 100 feet long with diameters up to 72-inches are commonly constructed in the Houston area. Longer lengths and larger diameters are certainly possible, but may require equipment and expertise not commonly available in the local area. Based on our preliminary calculations we recommend the following length vs. capacity should be used for the initial design.

<b>Shaft Length Below Bottom of Slab, Feet</b>	<b>Allowable Axial Capacity (inc. FS = 2) 36-inch Diameter Drilled Shaft, Tons</b>
90	200
105	250
120	300

## 4.2 Slope Stability

Stability analyses were conducted using the SLOPE/W 2007 slope stability program developed by GEO-SLOPE International Ltd. that calculates the factor of safety against slope failure. The slope stability analyses for each alternative are discussed in Section 5.

The factors of safety represent the calculated ratio of resisting forces and moments to the calculated driving forces and moments for the various potential failure surfaces analyzed. These forces and moments are based on the estimated unit weights and shear strengths of the various soils in the slope profile. Accordingly, a factor of safety of 1.0 indicates impending failure. The greater than 1.0 the factor is, the lower the risk of slope failure. As a practical matter, and in consideration of the variables and uncertainties involved, the risk cannot be reduced to zero. The goal is to reduce the risk of slope failure to a reasonable and acceptable level, with due consideration of the consequences of failure.

Slope stability analyses were performed for the End of Construction Case, Rapid Drawdown Case and Long Term Case. The following are the minimum required factors of safety for the different loading conditions that are expected during the lifetime of the project.

<b>Loading Condition</b>	<b>Required Minimum Factor of Safety</b>
End of Construction	1.30
Drawdown	1.25
Long-Term	1.50

End of Construction. The end of construction case models the initial undrained condition of the soil. For this analysis, unconfined compression soil parameters were used.

Drawdown. The drawdown case models the condition where dewatering of the berth creates a large unbalanced piezometric head in the bank slope. This unbalanced force increases the shear stresses in the bank soils. For this analysis, the groundwater elevation behind the slope is assumed at El. +1. The water level in the berth is lowered steadily to the berth bottom over a period of days. Consolidated undrained soil parameters were used in this analysis. The drawdown analysis was performed using the results of the seepage analysis described below.

Long Term. The long-term design case represents steady state piezometric and stress conditions. When a slope is excavated, altered stress conditions create pore pressure changes within the slope and the undrained strength of the bank soils is mobilized. With time, the soil pore pressures adjust to the imposed stress and piezometric conditions, and the bank soils rely on their available strength for long-term stability.

## 4.3 Retaining Wall Analyses

The design alternatives evaluated each include a king pile wall as part of the design. Alternate 3.0 includes a slurry pile wall as well. Analysis results for each alternative are discussed in Section 5.

King Pile Wall. A king pile retaining wall is a modification of a sheet pile retaining wall system in which structural steel sections such as H piles or circular steel piles are alternated with sheet pile sections. The benefit is an increase in the moment capacity and a decrease in horizontal deflection compared to sheet piles alone. For the dry berth design, use of king piles makes the option of a

cantilever retaining wall feasible in locations that would otherwise require a composite system such as a cellular cofferdam.

Analyses for the king pile walls were performed using PYWALL Version 2.0 by Ensoft. This program considers the soil structure interaction by using a generalized beam-column model and analyses the behavior of a flexible retaining wall with or without deadman or tieback support. The program represents the resistance provided by the soil using non-linear p-y curves which are commonly used for laterally loaded pile design. Since p-y curves were developed for single piles located away from other piles we need to adjust them to account for the continuous nature of the king pile wall. A p value modification factor of 0.57 was used to make this adjustment.

The loading on the wall was determined based on design cross sections provided by AECOM. Our analysis is based on a design equivalent fluid pressure of soil on the wall of 50 pcf. The design unit weight of water is taken as 63 pcf to account for brackish water. Where the excavation side ground surface slopes away from the wall the upper 5 feet of the soil on that side was neglected in the analysis (i.e. the wall as analyzed is 5 feet taller than shown in the cross section).

The total length of the wall was determined based on doubling the lateral load on the wall from the design cross section. Various lengths were evaluated and maximum deflections compared. The design length is based on the length at which the maximum deflections began to rise if the wall is further shortened.

Deadman Support. In some wall locations the cost of the wall system could be reduced by including lateral support near the top of the wall. Where such a support is possible the strength of the wall required (i.e. moment capacity) is reduced substantially. For this study we assumed a deadman structure comprised of short wall structures generating passive resistance connected with tie rods with the retaining wall where possible. The location of the deadman behind the retaining wall is important, it must be located far enough behind the wall such that the passive resistance is generated in soil that is unaffected by movement of the wall. The passive resistance is calculated based on the undrained shear strength and unit weight of the soil with a factor of safety of 2.

Slurry Wall. A slurry wall is a technique used to build reinforced-concrete walls. A trench is excavated to create a form for each wall. The trench is kept full of slurry at all times. The slurry prevents the trench from collapsing by providing outward pressure which balances the inward hydraulic forces and prevents water flow into the trench. Reinforcement is then lowered in and the trench is filled with concrete, which displaces the slurry. On completion of concreting, digging within the now concrete wall-enclosed area can proceed. To prevent the concrete wall from collapsing into the newly open area, tieback supports are installed.

Slurry walls were analyzed using PYWALL and the same procedures described for king pile walls above.

Tiebacks. A tieback is a wire or rod used to reinforce retaining walls for stability. Grouted tiebacks are constructed as steel rods or tendons drilled through a concrete wall out into the soil or bedrock on the other side. Grout is then pumped under pressure into the tieback anchor holes so that the rods can utilize soil resistance to prevent tieback pullout and wall destabilization.

Tiebacks were designed assuming an unbonded length behind the wall in the area which may be subject to deflection due to the presence of the wall. This area was taken as a zone bounded by a 45 line extending up from the base of excavation in front of the wall. The unbonded length was assumed to extend 10 feet behind this line. The capacity of the tieback is based on the bonded length and the diameter of the tieback. The allowable capacity was determined based on the soil shear strength including a factor of safety of 2. The following allowable soil-grout friction values were used in the design.

- Above El. -25: 250 psf
- El. -26 to El. -40: 750 psf
- El. -40 and below: 1000 psf

#### 4.4 Seepage Analyses

Seepage analysis was performed for the various alternatives using SEEP/W 2007 developed by GEO-SLOPE International Ltd. This is a finite element software product for analyzing groundwater seepage and excess pore-water pressure dissipation problems within porous materials such as soil and rock. The hydraulic conductivity for the seepage analysis was determined based on the results of in situ slug tests in piezometers installed during the Part 1 field investigation; the results of those tests are presented in the geotechnical data report.

Seepage analyses were performed for many cross sections for the various alternatives. The results were similar. For the sloped sections of the berth the estimated seepage rate is 20 gallons per day per linear foot of slope. For the wall sections, the seepage through the soil around the wall was negligible, and any seepage that does occur will be determined by the amount of water that penetrates the wall structure.

### 5. ALTERNATIVES EVALUATED

#### 5.1 Alternative 1.2.1

In this alternative the berth is located at about the current location with top of slab at El. -26 constructed with sloping sides and cantilever king pile walls. Appendix B presents a plan of this alternate along with design cross sections provided to us by AECOM.

Keel Block Foundation. The keel block foundation design is presented in Section 4.1.

Slope Stability. The required berth side slope was analyzed as described in Section 4.2. Based on the berth bottom elevation at El. -26 our analysis shows that a side slope at 3H:1V provides an adequate factor of safety. The drawdown analysis shows that dewatering the berth over a period of at least 14 days will maintain the required factor of safety during drawdown. The results of the slope stability analysis are presented in Appendix B.

Retaining Walls. Selected cross sections shown in Appendix B were analyzed as discussed in Section 4.3. The results of our analyses are shown in Appendix B and summarized below.

Section	Wall Height, Feet	Length, Feet	I, in <sup>4</sup> /ft	Max. Deflection		Max. Moment	
				Inches	Depth, ft	ft-kip	Depth, ft
B w/deadman (& A)	33	65	2413.8	0.8	18	129.2	21
C (& D)	43	110	11000.0	10.8	0	1200.0	55
E (& E')	23	70	3448.3	5.7	0	392.5	34
F	33	110	3448.3	8.9	0	489.2	44
G (& F')	35	110	11000.0	6.7	0	891.7	49

Notes:

1. The Section B analysis includes a lateral support at a depth of 2 feet with force of 10.5 kips/linear foot. Due to the shallow depth we recommend a deadman anchor. The

deadman anchor can be designed as a slab designed based on an allowable passive resistance of 1.5 ksf. This gives a continuous slab 7 feet high. The slab needs to be located at least 45 feet behind the top of the wall.

2. Moment of Inertia (I) values for sections B, E, and F do not correspond to a specific structural sheeting. It was selected in order to develop reasonable deflections. The results should be checked once a specific structural sheeting is selected. Maximum deflection is sensitive to I, maximum moment is not.

Seepage. The seepage analysis procedures and results are presented in Section 4.4.

## 5.2 Alternative 1.3

In this alternative the berth is located at about the current location with top of slab at El. -38 constructed with sloping sides and cantilever king pile walls. Appendix C presents a plan of this alternate along with design cross sections provided to us by AECOM.

Keel Block Foundation. The keel block foundation design is presented in Section 4.1.

Slope Stability. The required berth side slope was analyzed as described in Section 4.2. Based on the berth bottom elevation at El. -38 our analysis shows that a side slope at 4H:1V provides an adequate factor of safety. The drawdown analysis shows that dewatering the berth over a period of at least 14 days will maintain the required factor of safety during drawdown. The results of the slope stability analysis are presented in Appendix C.

Retaining Walls. Selected cross sections shown in Appendix C were analyzed as discussed in Section 4.3. The results of our analyses are shown in Appendix C and summarized below.

Section	Wall Height, Feet	Length, Feet	I, in <sup>4</sup> /ft	Max. Deflection		Max. Moment	
				Inches	Depth, ft	ft-kip	Depth, ft
A w/deadman (& B)	45	80	241.4	2.1	25	261.7	25
C (& D, D')	46	110	11000.0	12.4	0	1266.7	58
E' (& E)	38	110	11000.0	8.4	0	1033.3	51
F	33	75	11000.0	1.5	0	260.8	46
G	43	110	11000.0	11.6	0	1266.7	54

Notes:

1. The Section A analysis includes a lateral support at a depth of 2 feet with force of 16 kips/linear foot. Due to the shallow depth we recommend a deadman anchor. The deadman anchor can be designed as a slab designed based on an allowable passive resistance of 1.5 ksf. This gives a continuous slab 11 feet high. The slab needs to be located at least 60 feet behind the top of the wall.
2. Moment of Inertia (I) values for section A does not correspond to a specific structural sheeting. It was selected in order to develop reasonable deflections. The results should be checked once a specific structural sheeting is selected. Maximum deflection is sensitive to I, maximum moment is not.

Seepage. The seepage analysis procedures and results are presented in Section 4.4.

### 5.3 Alternative 2.2B

In this alternative the berth is located north of the current location with top of slab at El. -38 constructed with sloping sides and cantilever king pile walls. Appendix D presents a plan of this alternate along with design cross sections provided to us by AECOM.

Keel Block Foundation. The keel block foundation design is presented in Section 4.1.

Slope Stability. The required berth side slope was analyzed as described in Section 4.2. Based on the berth bottom elevation at El. -38 our analysis shows that a side slope at 4H:1V provides an adequate factor of safety. The drawdown analysis shows that dewatering the berth over a period of at least 14 days will maintain the required factor of safety during drawdown. The results of the slope stability analysis are presented in Appendix D.

Retaining Walls. Selected cross sections shown in Appendix D were analyzed as discussed in Section 4.3. The results of our analyses are shown in Appendix D and summarized below.

Section	Wall Height, Feet	Length, Feet	I, in <sup>4</sup> /ft	Max. Deflection		Max. Moment	
				Inches	Depth, ft	ft-kip	Depth, ft
B (& A, C)	33	110	11000	5.16	0	737.5	47
D	16	65	11000	0.59	0	171.67	27
E	14	55	1724.1	0.41	0	29	26
F	35	110	16000	7.2	0	1191.67	55
F	35	110	11000	9.8	0	1183.33	55

Notes:

1. Moment of Inertia (I) value for sections D and E does not correspond to a specific structural sheeting. It was selected in order to develop reasonable deflections. The results should be checked once a specific structural sheeting is selected. Maximum deflection is sensitive to I, maximum moment is not.

Seepage. The seepage analysis procedures and results are presented in Section 4.4.

### 5.4 Alternative 3.0

In this alternative the berth is located north of the current location with top of slab at El. -38 constructed with sloping sides and cantilever king pile walls. Appendix E presents a plan of this alternate along with design cross sections provided to us by AECOM.

Keel Block Foundation. The keel block foundation design is presented in Section 4.1.

Slope Stability. This alternative does not include a slope as part of the design.

Retaining Walls. Selected cross sections shown in Appendix E were analyzed as discussed in Section 4.3. The results of our analyses are shown in Appendix E and summarized below.

Section	Wall Height, Feet	Length, Feet	I, in <sup>4</sup> /ft	Max. Deflection		Max. Moment	
				Inches	Depth, ft	ft-kip/ft	Depth, ft
A (& B,C)	26	65	2413.8	4.5	0	255.0	36
D (& D')	35	80	6896.6	4.5	0	463.3	46
E	51	125	16000.0	19.4	0	2133.3	56
Slurry Wall (water @ +3)	52	80	9444.4	0.87	33	100.0	60
Slurry Wall (water @ +13)	52	80	9444.4	1.07	33	116.7	60

Notes:

1. The Slurry Wall analysis includes lateral supports at a depth of 10, 25, and 38 feet with horizontal force of 24.3, 37.2, and 47.9 kips/linear foot. We recommend tieback anchors to support these loads installed at an angle of 2H:1V (26.56°). This is a relatively steep angle but needed to provide capacity for the tiebacks. We evaluated the tieback length required for 12-inch diameter tiebacks if the spacing is 6 feet. The capacities and lengths are as follows:  
  
Level 1: Required Tieback Capacity = 177.7 kips, Unbonded Length = 41.7 Feet, Total Length = 125.1 Feet  
Level 2: Required Tieback Capacity = 256.2 kips, Unbonded Length = 30.5 Feet, Total Length = 122.2 Feet  
Level 3: Required Tieback Capacity = 321.4 kips, Unbonded Length = 20.8 Feet, Total Length = 127.0 Feet
2. Moment of Inertia (I) values for sections A and D do not correspond to a specific structural sheeting. It was selected in order to develop reasonable deflections. The results should be checked once a specific structural sheeting is selected. Maximum deflection is sensitive to I, maximum moment is not.

Seepage. The seepage analysis procedures and results are presented in Section 4.4.

## 6. LIMITATIONS

This study was performed for the exclusive use of AECOM for alternatives analysis for the proposed dry berth of Battleship Texas in Houston, Texas. The analyses presented are intended for preliminary evaluation of alternative concepts for the dry berth. They are not intended as a basis for final design or construction. Once the preferred alternative has been selected additional field investigation, laboratory testing, and engineering analysis will be required prior to development of final plans and specifications.

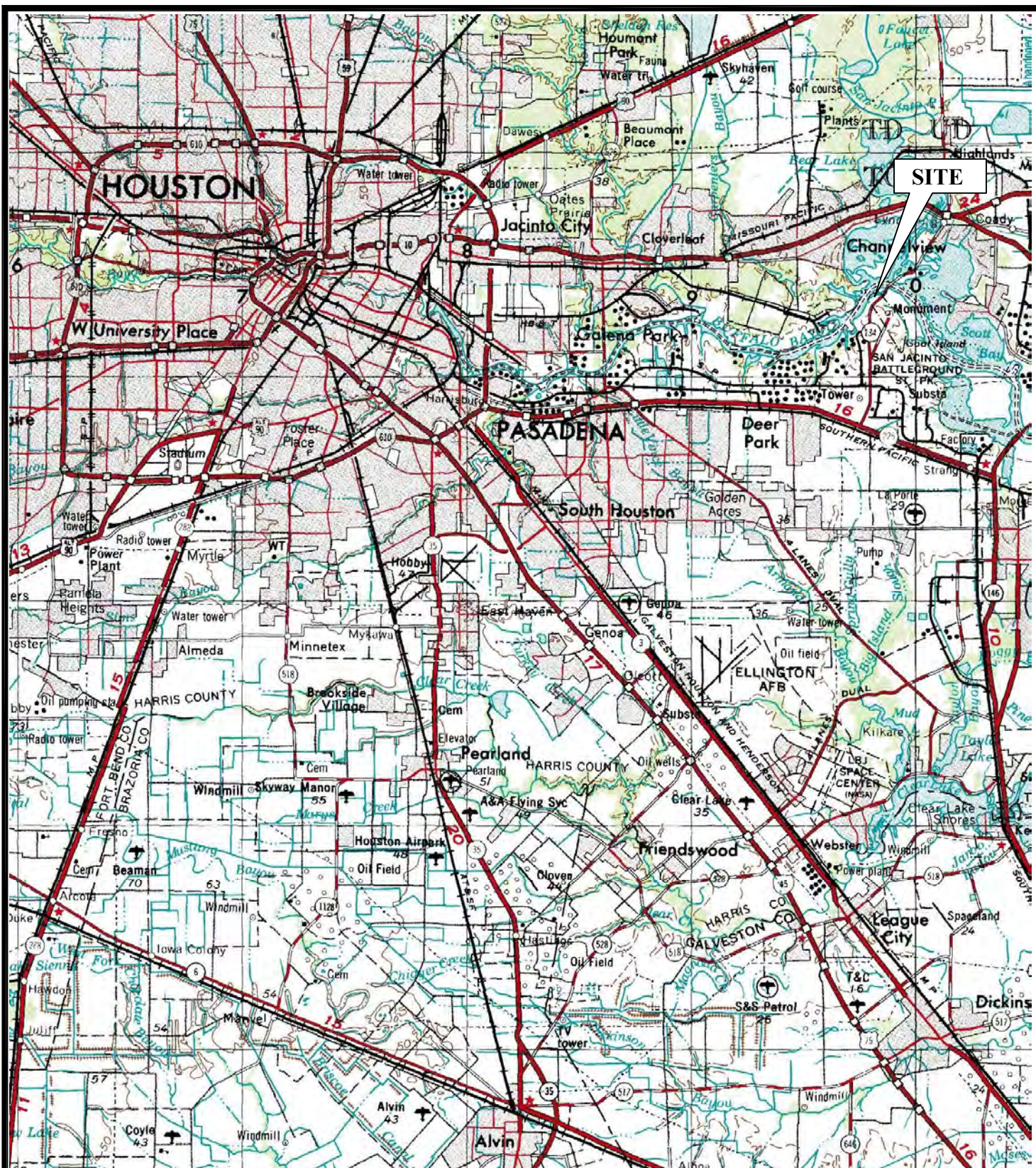
HVJ Associates, Inc. has endeavored to comply with generally accepted geotechnical engineering practice common in the local area. HVJ Associates, Inc. makes no warranty, express or implied. The analyses and recommendations contained in this report are based on data obtained from subsurface exploration, laboratory testing, the project information provided to us and our experience with similar soils and site conditions. The methods used indicate subsurface conditions only at the specific locations where samples were obtained, only at the time they were obtained, and only to the

depths penetrated. Samples cannot be relied on to accurately reflect the strata variations that usually exist between sampling locations. Should any subsurface conditions other than those described in our boring logs be encountered, HVJ Associates should be immediately notified so that further investigation and supplemental recommendations can be provided.



## ILLUSTRATIONS





6120 S. Dairy Ashford Road  
Houston, Texas 77072-1010  
281.933.7388 Ph  
281.933.7293 Fax

DATE: 02/24/2011

APPROVED BY:  
SV

PREPARED BY:  
NL

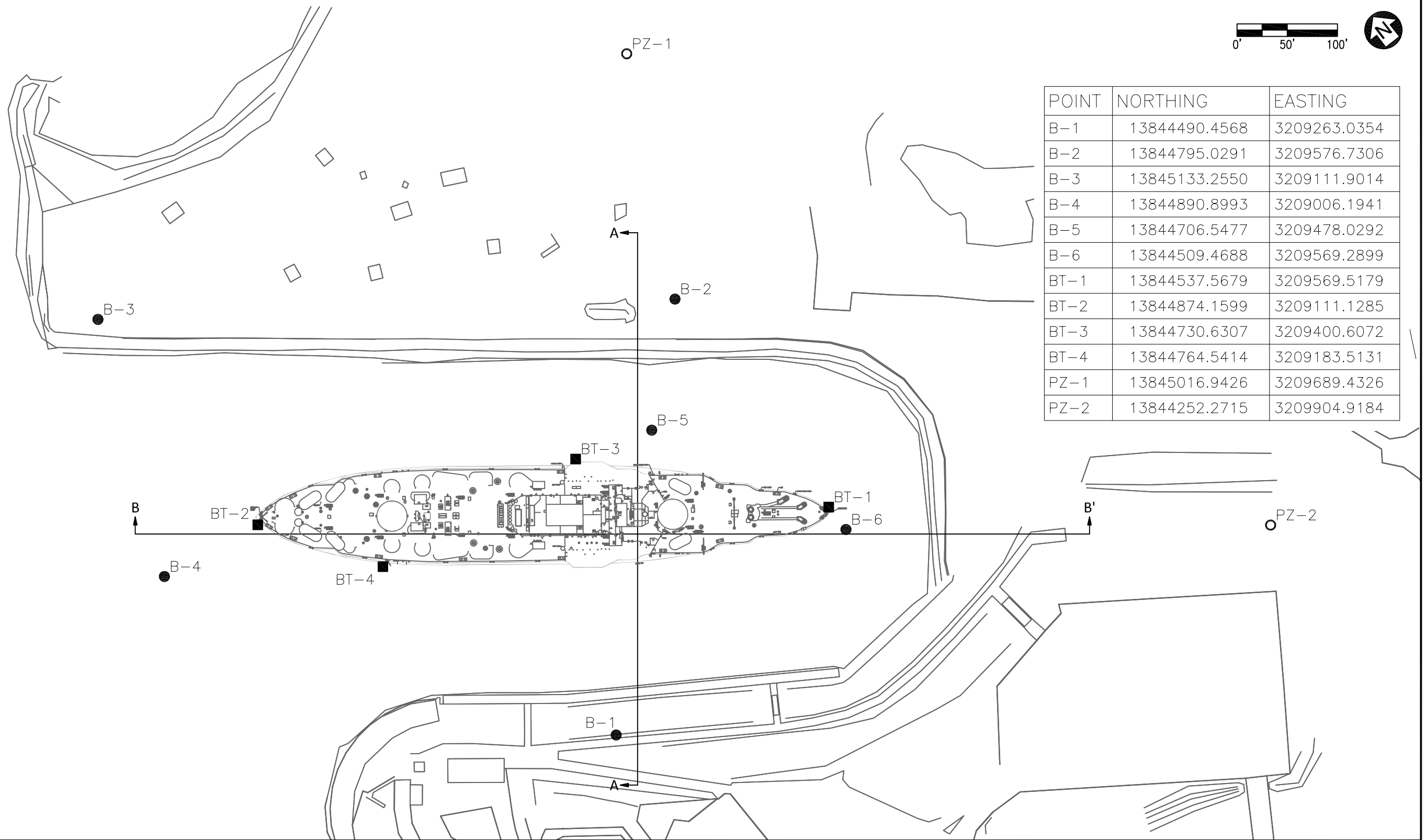
SITE VICINITY PLAN  
BATTLESHIP TEXAS

PROJECT NO.:  
HG1015021

DRAWING NO.:  
PI AT F 1



DATE: 2/25/2011 2:25:53 PM  
FILE: C:\Documents and Settings\Reuben\Desktop\Battleship Texas\Battleship\_Boring\_Logs.dwg



POINT	NORTHING	EASTING
B-1	13844490.4568	3209263.0354
B-2	13844795.0291	3209576.7306
B-3	13845133.2550	3209111.9014
B-4	13844890.8993	3209006.1941
B-5	13844706.5477	3209478.0292
B-6	13844509.4688	3209569.2899
BT-1	13844537.5679	3209569.5179
BT-2	13844874.1599	3209111.1285
BT-3	13844730.6307	3209400.6072
BT-4	13844764.5414	3209183.5131
PZ-1	13845016.9426	3209689.4326
PZ-2	13844252.2715	3209904.9184

LEGEND

- BORING
- PIEZOMETER
- ENVIRONMENTAL GRAB SAMPLE

SEE PLATES 3A & 3B  
FOR SECTION VIEWS



SCALE: 1" = 100'

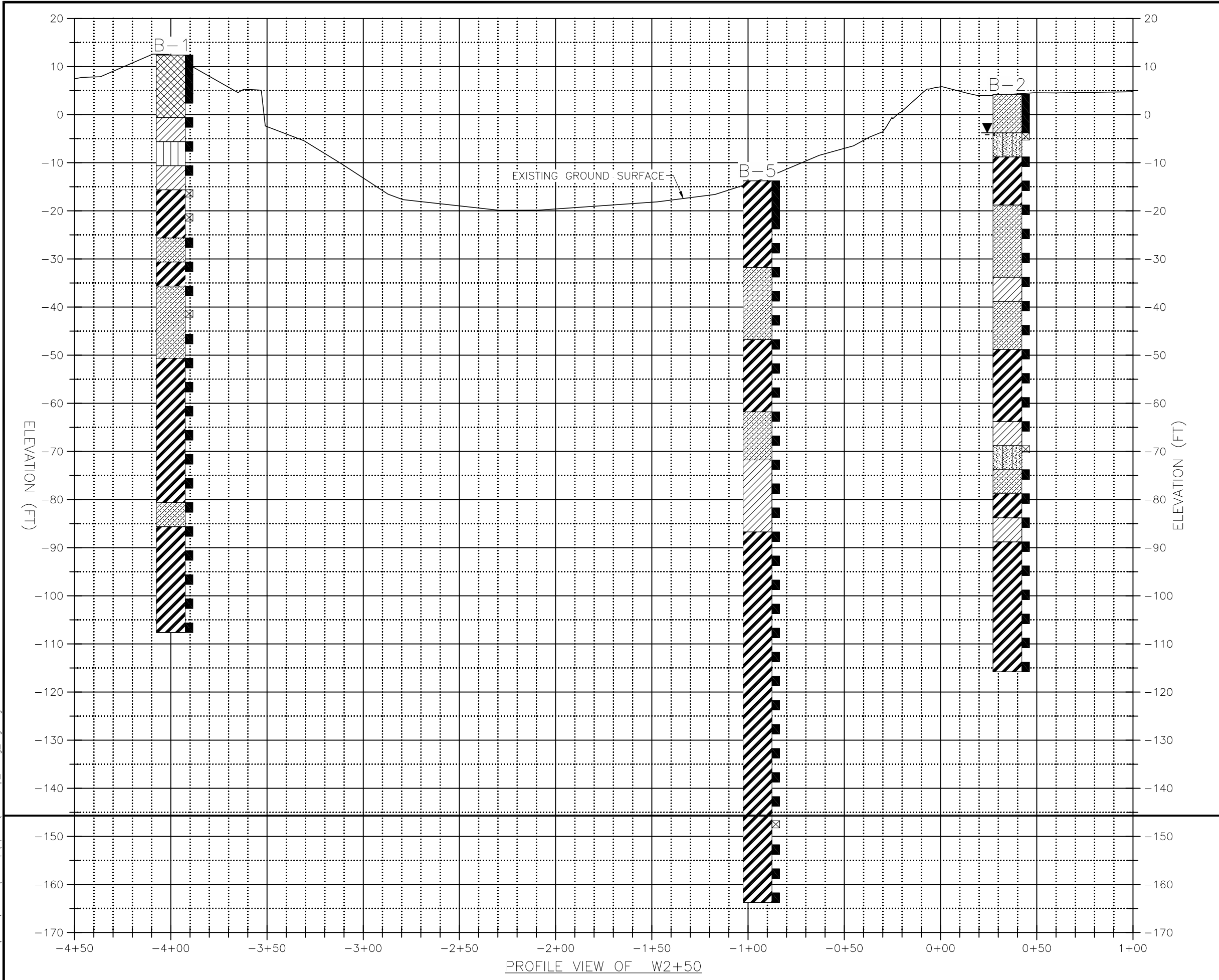
DATE: 2/25/2011

DRAWN BY: RJ	PROJ. CHK: SV	APPRV. BY: MH
-----------------	------------------	------------------

BATTLESHIP TEXAS  
PLAN OF BORINGS

PROJECT NO.: HG1015021	FILENAME: BATTLESHIP_BORING_LOGS	PLATE 2
---------------------------	-------------------------------------	---------

DATE: 8/24/2011 2:52:59 PM  
FILE: C:\Users\Reuben\Desktop\Upload\ Battleship\_Boring\_Logs.dwg



SOIL SYMBOLS

Soil Types			
Clay	Silt	Sand	Fill
Modifiers			
Clayey	Silty	Sandy Clay	Cemented
Construction Materials			
Asphaltic Concrete	Stabilized Base	Fill or Debris	Base

SAMPLER TYPES

	Thin Walled Shelby Tube		No Recovery
	Split Barrel		Auger
	Liner Tube		Jar Sample

SCALE: 1" = 50'H 20'V

DATE: 8/24/2011

DRAWN BY: RJ

PROJ. CHK: SV

APPRV. BY: MH

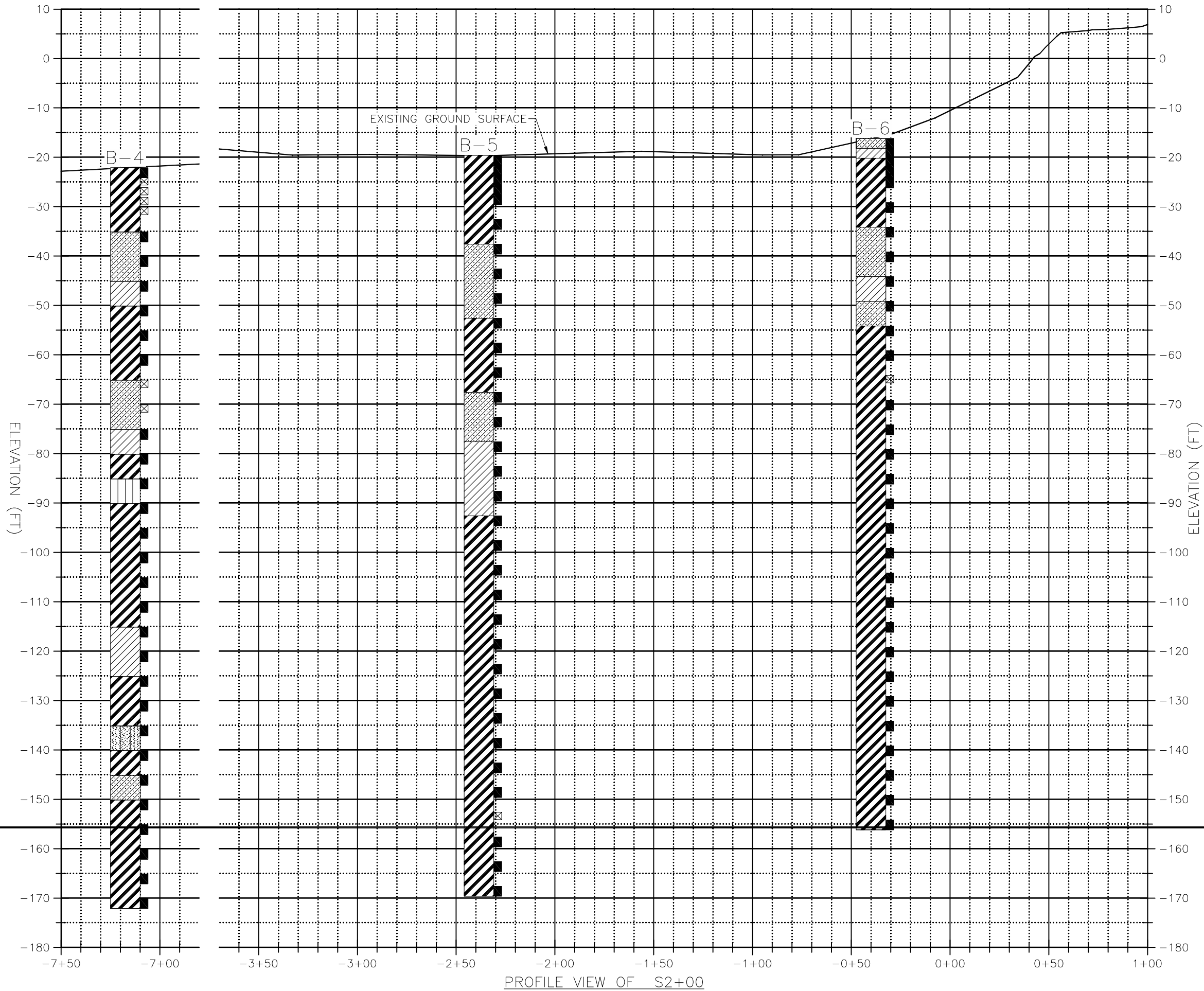
BATTLESHIP TEXAS  
PROFILE WITH BORING LOGS  
ALIGNMENT "W2+50"  
SECTION A-A'

PROJECT NO.: HG1015021

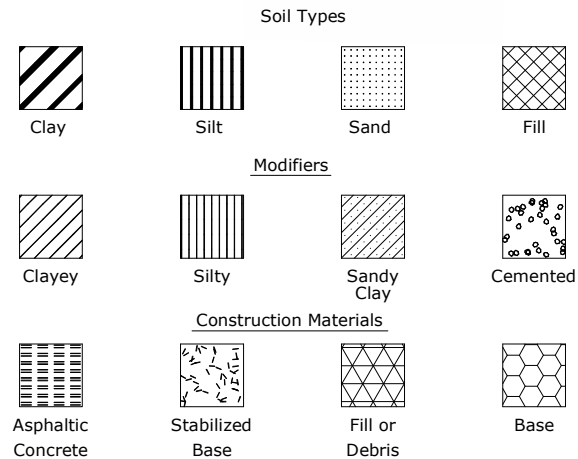
FILENAME: BATTLESHIP\_BORING\_LOGS

PLATE 3A

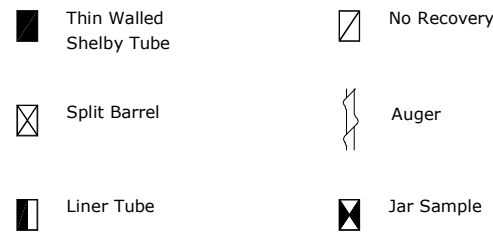
DATE: 8/24/2011 2:53:25 PM  
FILE: C:\Users\Reuben\Desktop\Upload\Battleship\_Boring\_Logs.dwg



### SOIL SYMBOLS

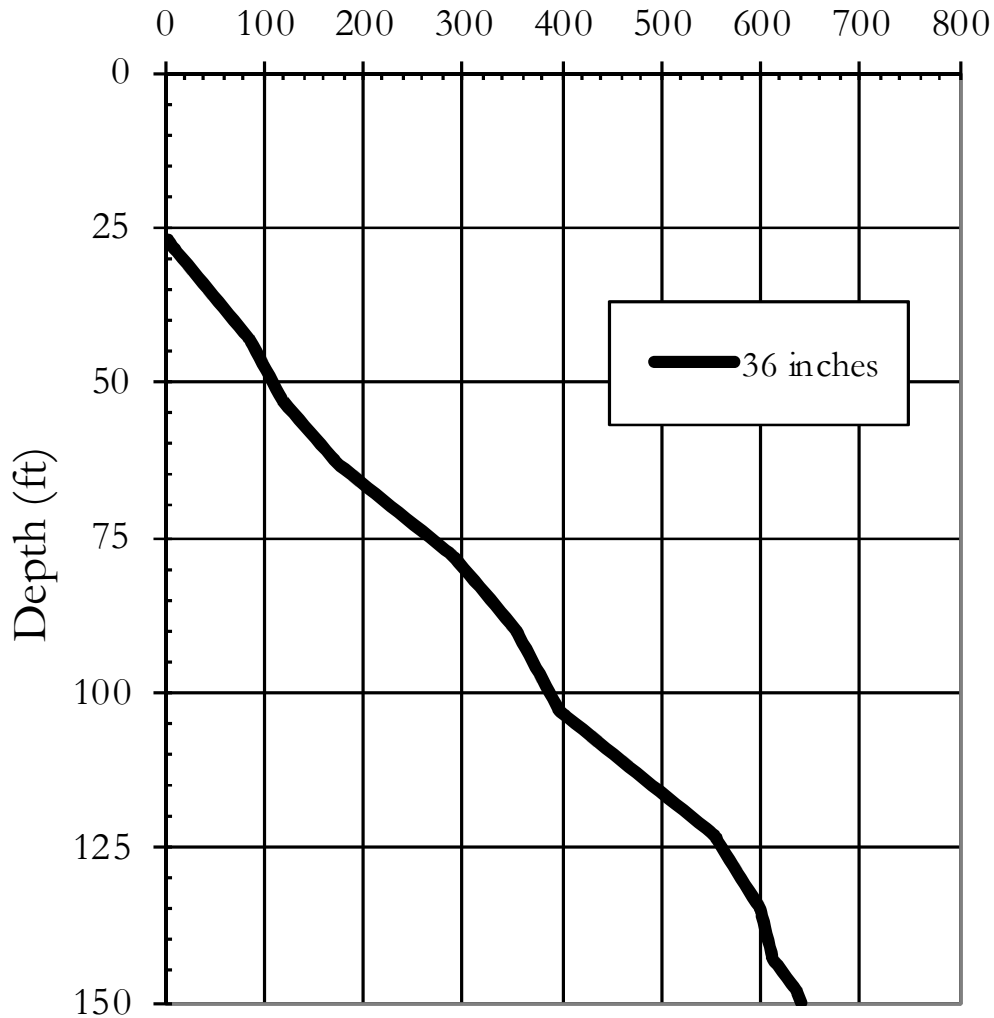


### SAMPLER TYPES



	SCALE: 1" = 50'H 20'V		
	DATE: 8/24/2011		
	DRAWN BY: RJ	PROJ. CHK: SV	APPRV. BY: MH
	BATTLESHIP TEXAS PROFILE WITH BORING LOGS ALIGNMENT "S2+00" SECTION B-B'		
PROJECT NO.: HG1015021		FILENAME: BATTLESHIP_BORING_LOGS	PLATE 3B

## Ultimate Skin Friction Capacity (Tons)



**Note:**

Calculation assumes top of shaft at El. -35 which is 21.5 feet below top of boring. To determine actual penetration subtract 21.5 feet from depth shown.

Note:

Allowable axial capacity may be calculated by applying a factor of safety of two to the ultimate capacity shown and allowable uplift capacity may be calculated by applying a factor of safety of three to the ultimate capacity.



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DATE: 01/28/2011

APPROVED BY:  
SV

PREPARED BY:  
DM

ULTIMATE SKIN FRICTION CAPACITY  
BATTLESHIP DRILLED SHAFTS (B-5)

PROJECT NO.:  
HG1015021

DRAWING NO.:  
PLATE 4

**APPENDIX A**  
**BORING LOGS**

# LOG OF BORING

Project: Battleship Texas

Boring No.: B-1

Groundwater during drilling: ---

Groundwater after drilling: ---

Date: 11/18/2010

Northing: 13,844,490.5

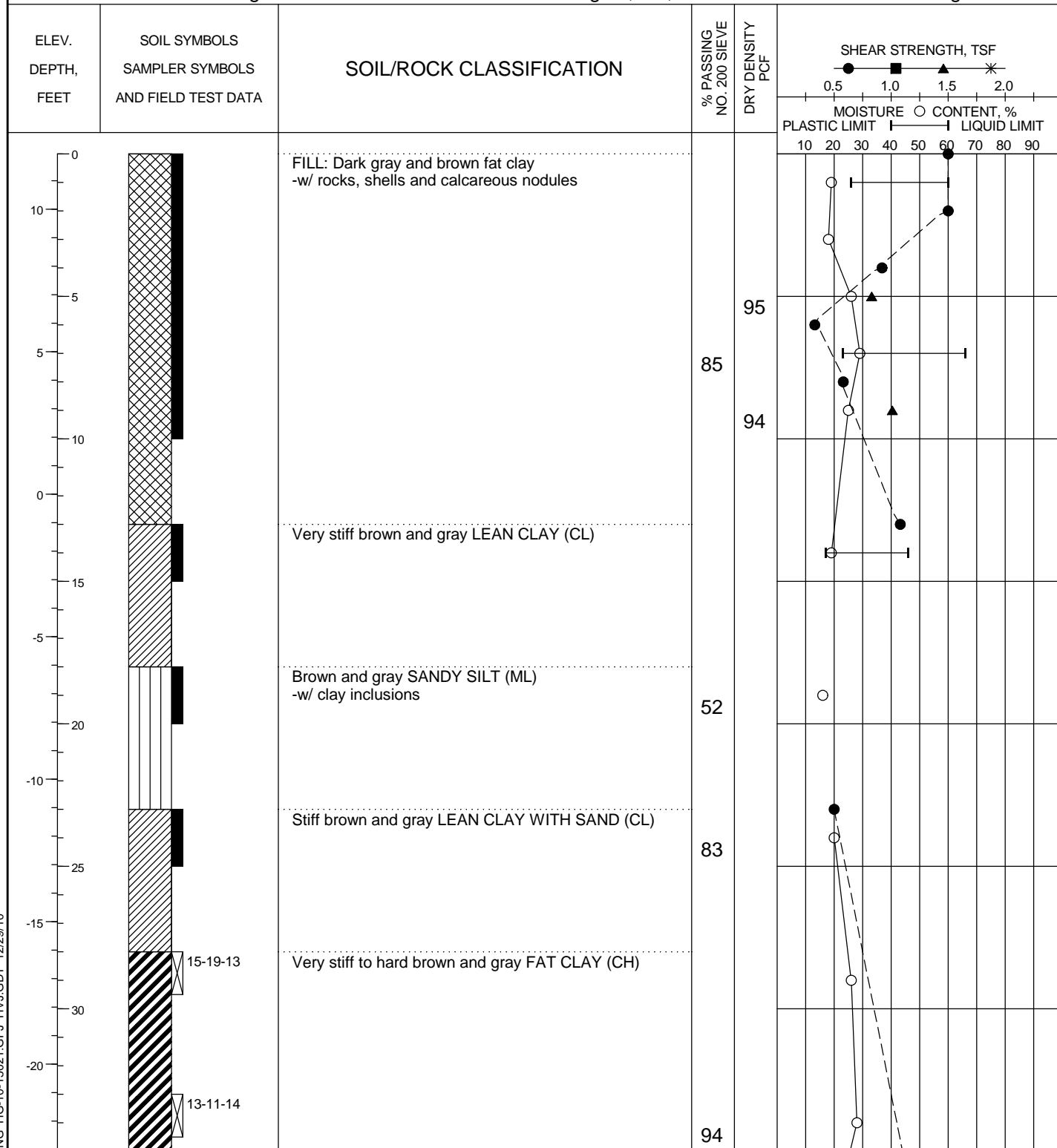
Easting: 3,209,263.0

Project No.: HG1015021

Elevation: 11.94 feet

Local Coord. Northing: -399.24

Local Coord. Easting: -271.90



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-1a



# LOG OF BORING

Project: Battleship Texas

Boring No.: B-1

Groundwater during drilling: ---

Groundwater after drilling: ---

Date: 11/18/2010

Northing: 13,844,490.5

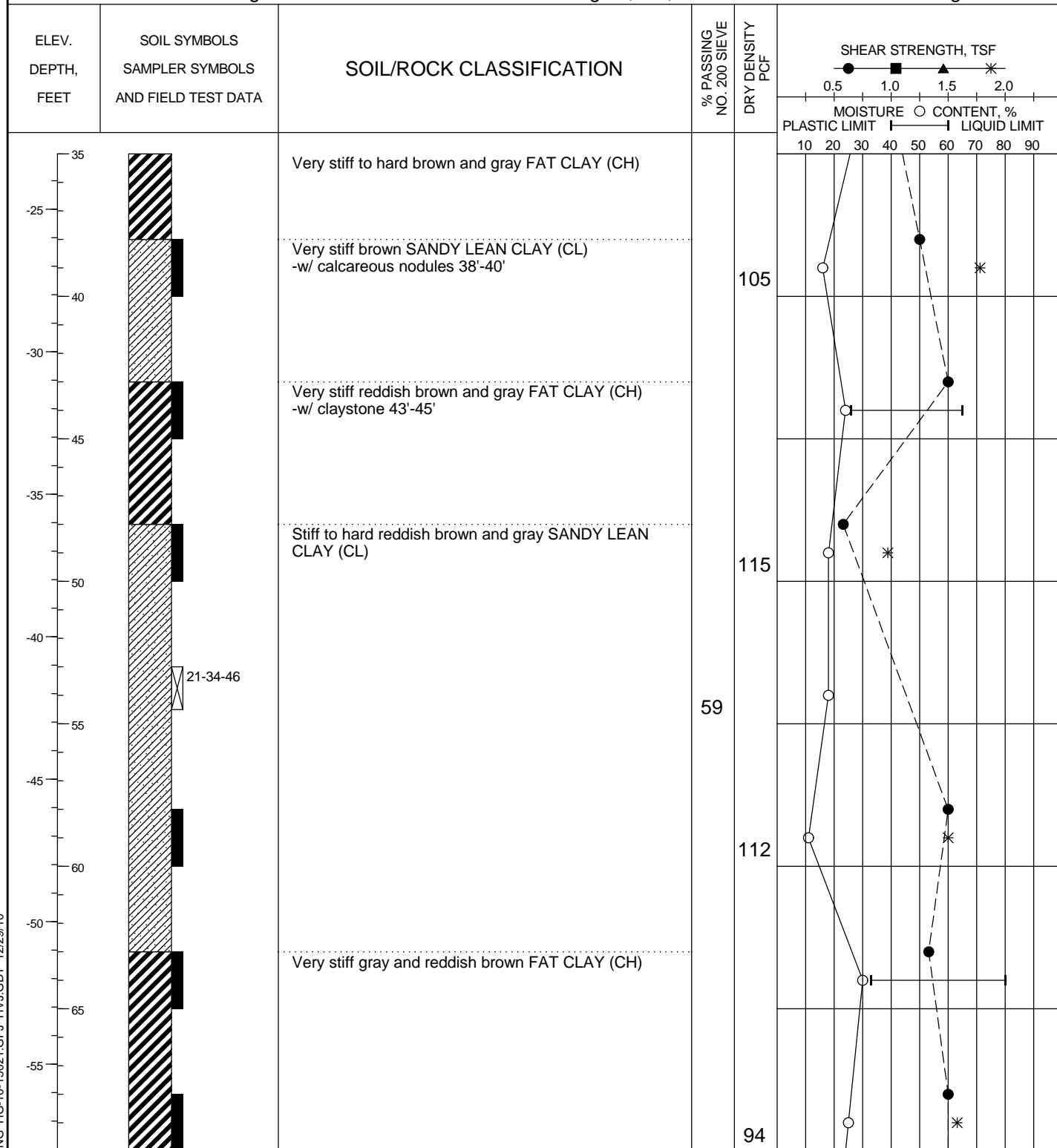
Easting: 3,209,263.0

Project No.: HG1015021

Elevation: 11.94 feet

Local Coord. Northing: -399.24

Local Coord. Easting: -271.90



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-1b



LOG OF SOIL BORING HG-10-15021.GPJ HVJ.GDT 12/29/10

# LOG OF BORING

Project: Battleship Texas

Boring No.: B-1

Groundwater during drilling: ---

Groundwater after drilling: ---

Date: 11/18/2010

Northing: 13,844,490.5

Easting: 3,209,263.0

Project No.: HG1015021

Elevation: 11.94 feet

Local Coord. Northing: -399.24

Local Coord. Easting: -271.90

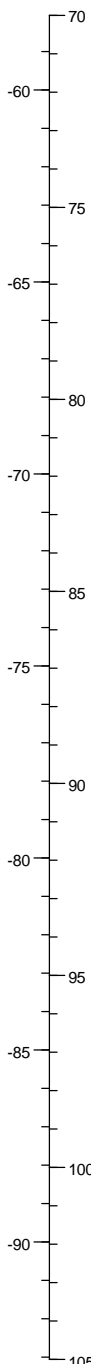
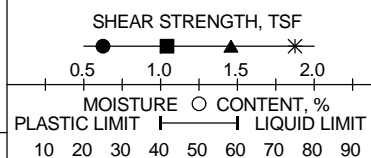
ELEV.  
DEPTH,  
FEET

SOIL SYMBOLS  
SAMPLER SYMBOLS  
AND FIELD TEST DATA

SOIL/ROCK CLASSIFICATION

% PASSING  
NO. 200 SIEVE

DRY DENSITY  
PCF



Very stiff gray and reddish brown FAT CLAY (CH)

-w/ sand pockets 78'-80'

Very stiff reddish brown SANDY LEAN CLAY (CL)

Stiff to very stiff reddish brown and gray FAT CLAY (CH)

99

91

87

Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-1c



LOG OF SOIL BORING HG-10-15021.GPJ HVJ.GDT 12/29/10

# LOG OF BORING

Project: Battleship Texas

Boring No.: B-1

Groundwater during drilling: ---

Groundwater after drilling: ---

Date: 11/18/2010

Northing: 13,844,490.5

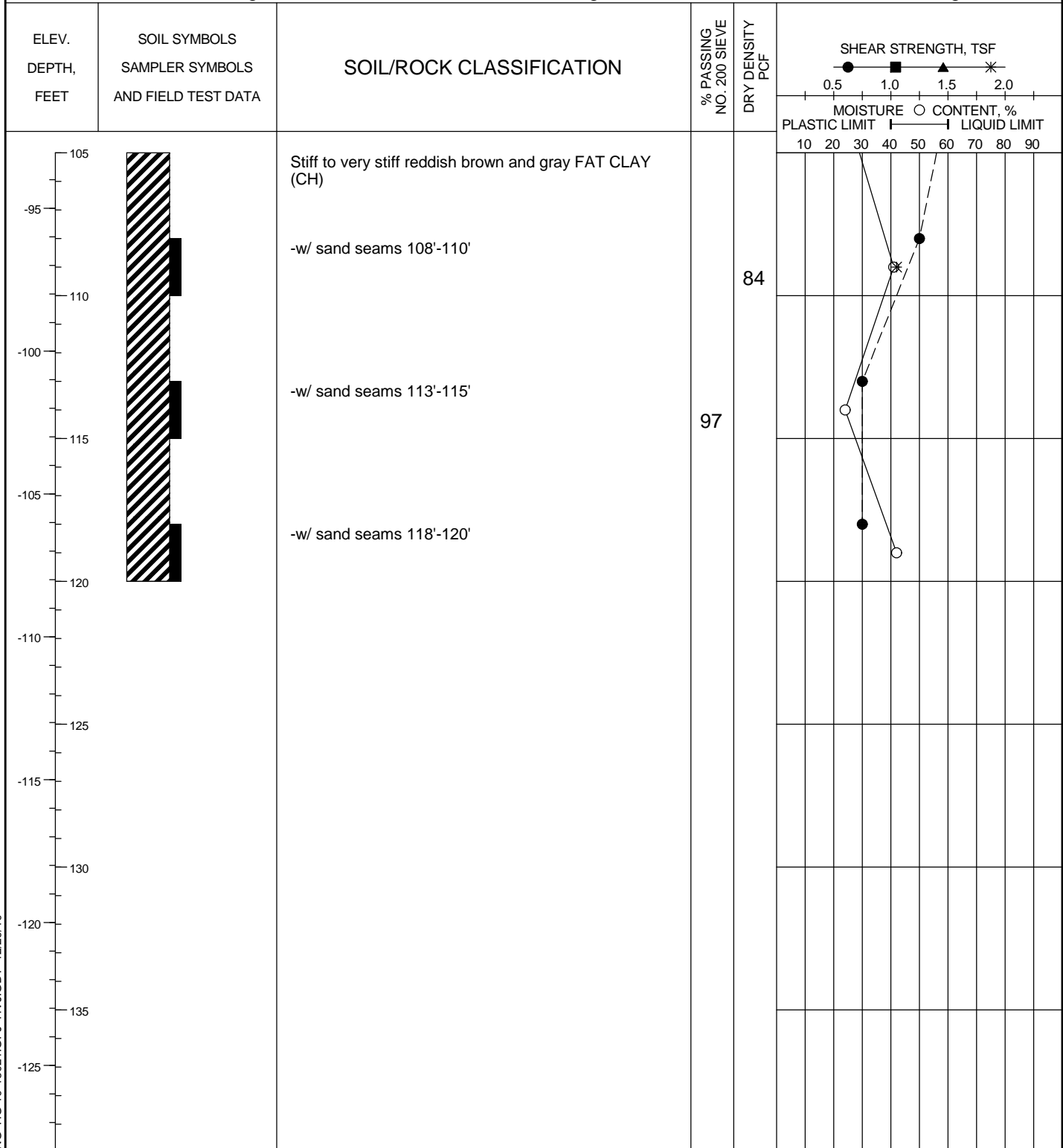
Easting: 3,209,263.0

Project No.: HG1015021

Elevation: 11.94 feet

Local Coord. Northing: -399.24

Local Coord. Easting: -271.90



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

✱ = UU Triaxial

See Plate 2 for boring location.

PLATE A-1d

LOG OF SOIL BORING HG-10-15021.GPJ HVJ.GDT 12/29/10



# LOG OF BORING

Project: Battleship Texas

Boring No.: B-2

Groundwater during drilling: 8 feet

Groundwater after drilling: ---

Date: 11/17/2010

Northing: 13,844,795.0

Easting: 3,209,576.7

Project No.: HG1015021

Elevation: 4.34 feet

Local Coord. Northing: 33.96

Local Coord. Easting: -212.68

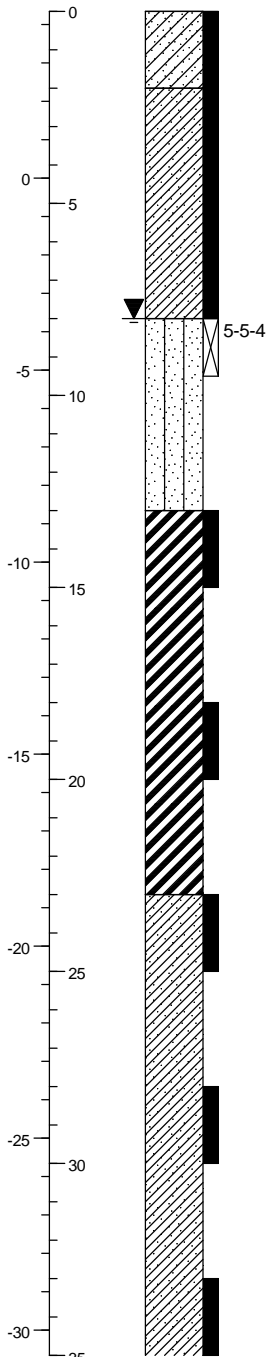
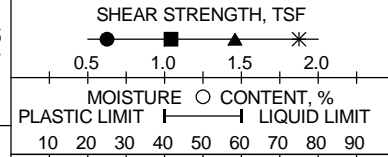
ELEV.  
DEPTH,  
FEET

SOIL SYMBOLS  
SAMPLER SYMBOLS  
AND FIELD TEST DATA

SOIL/ROCK CLASSIFICATION

% PASSING  
NO. 200 SIEVE

DRY DENSITY  
PCF



Brown CLAYEY SAND (SC)

Stiff brown and gray SANDY LEAN CLAY (CL)

Loose brown SILTY SAND (SM)

Very soft to firm dark gray FAT CLAY (CH)

Very soft to very stiff brown and gray SANDY LEAN CLAY (CL)

19

50

28

67

119

108

Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-2a

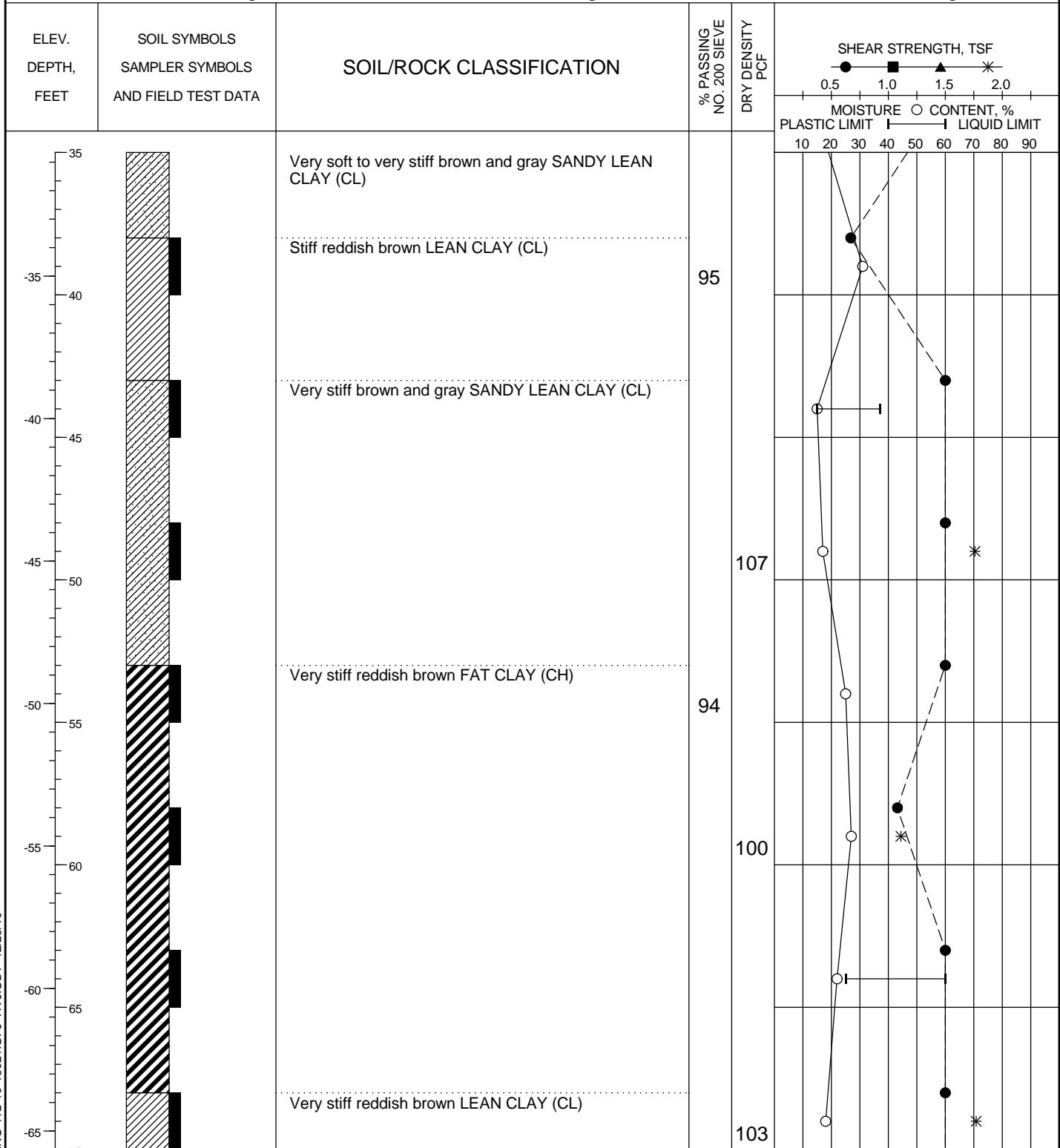
LOG OF SOIL BORING HG-10-15021.GPJ HVJ.GDT 12/29/10

# LOG OF BORING

Project: Battleship Texas  
Boring No.: B-2  
Groundwater during drilling: 8 feet  
Groundwater after drilling: ---

Date: 11/17/2010  
Northing: 13,844,795.0  
Easting: 3,209,576.7

Project No.: HG1015021  
Elevation: 4.34 feet  
Local Coord. Northing: 33.96  
Local Coord. Easting: -212.68



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. \* = UU Triaxial

See Plate 2 for boring location.

PLATE A-2b

LOG OF SOIL BORING HG-10-15021.GPJ HVJ.GDT 12/29/10



# LOG OF BORING

Project: Battleship Texas

Boring No.: B-2

Groundwater during drilling: 8 feet

Groundwater after drilling: ---

Date: 11/17/2010

Northing: 13,844,795.0

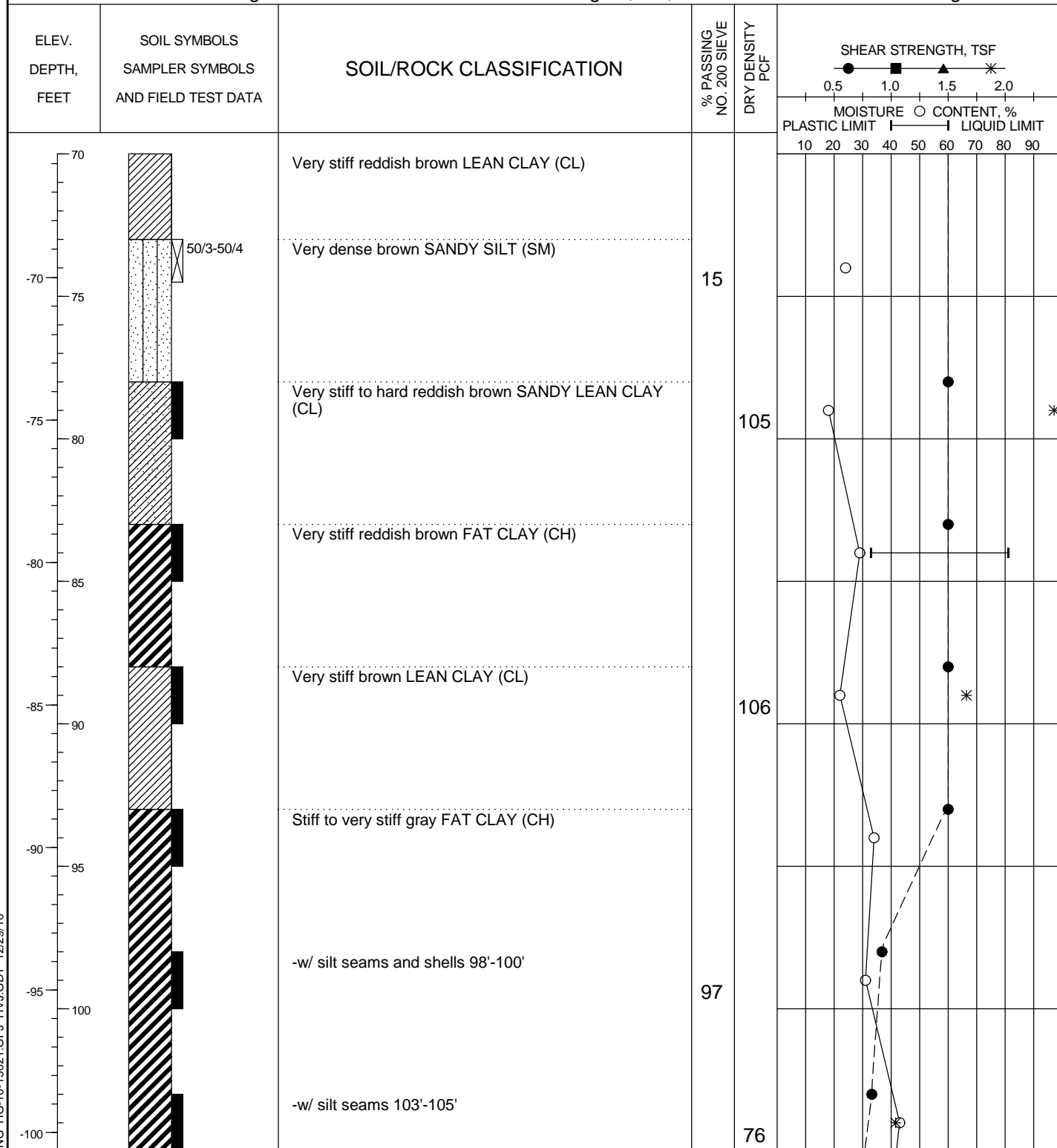
Easting: 3,209,576.7

Project No.: HG1015021

Elevation: 4.34 feet

Local Coord. Northing: 33.96

Local Coord. Easting: -212.68



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-2c

# LOG OF BORING

Project: Battleship Texas

Boring No.: B-2

Groundwater during drilling: 8 feet

Groundwater after drilling: ---

Date: 11/17/2010

Northing: 13,844,795.0

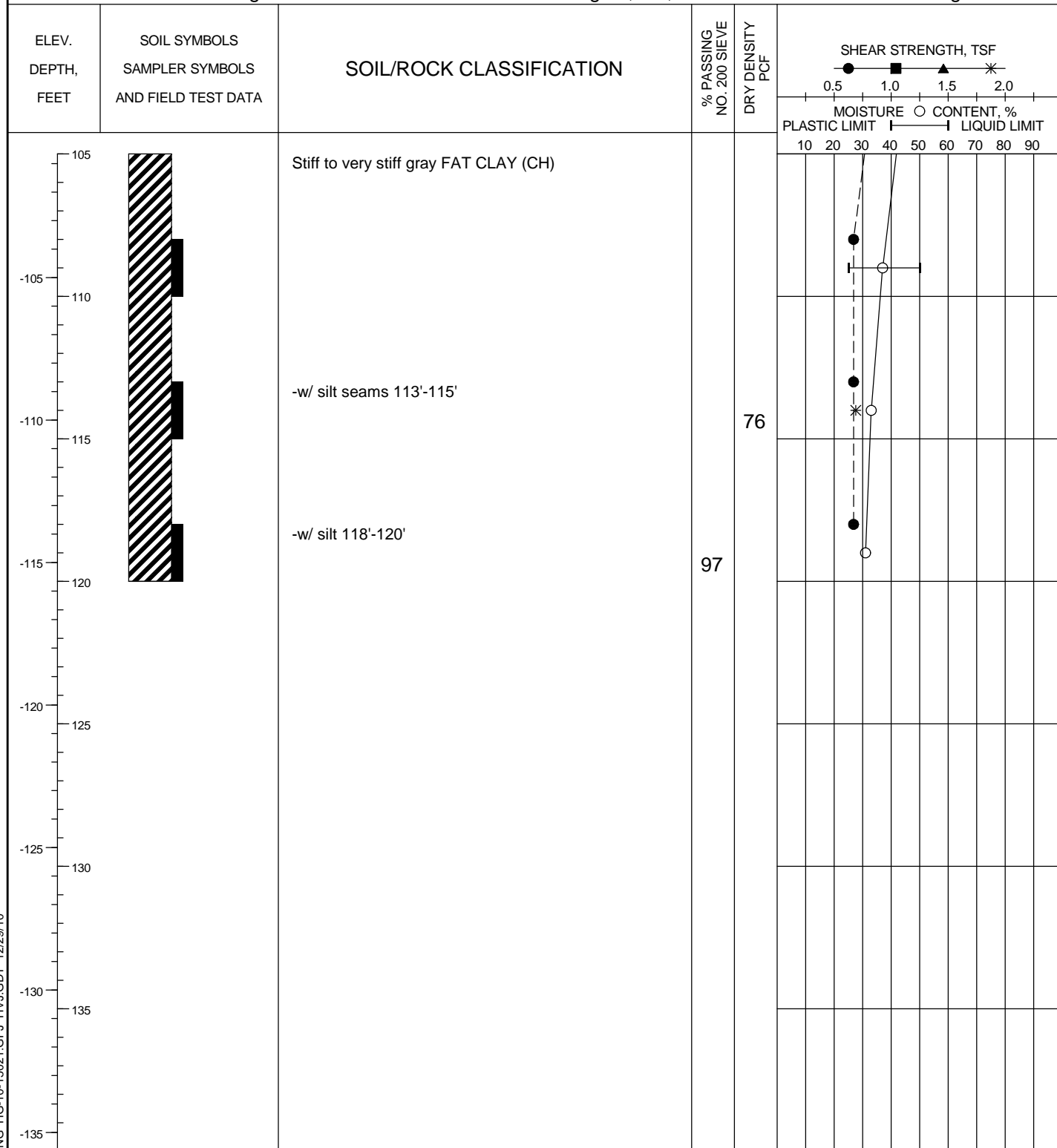
Easting: 3,209,576.7

Project No.: HG1015021

Elevation: 4.34 feet

Local Coord. Northing: 33.96

Local Coord. Easting: -212.68



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

✱ = UU Triaxial

See Plate 2 for boring location.

PLATE A-2d



# LOG OF BORING

Project: Battleship Texas

Boring No.: B-3

Groundwater during drilling: 5 feet

Groundwater after drilling: ---

Date: 11/22/2010

Northing: 13,845,133.3

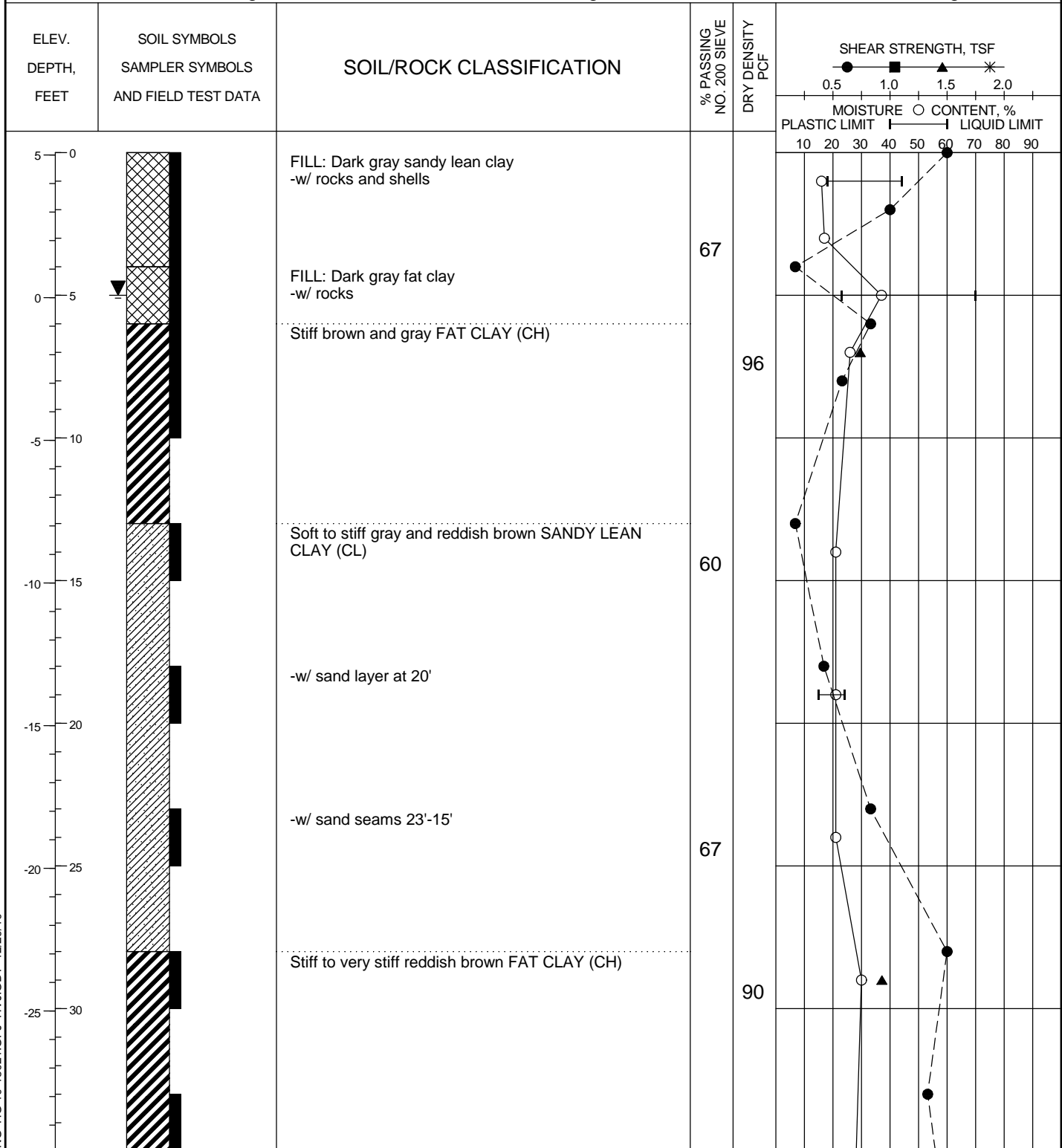
Easting: 3,209,111.9

Project No.: HG1015021

Elevation: 5.08 feet

Local Coord. Northing: 13.7

Local Coord. Easting: -787.18



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-3a

LOG OF SOIL BORING HG-10-15021.GPJ HVJ.GDT 12/29/10



# LOG OF BORING

Project: Battleship Texas

Boring No.: B-3

Groundwater during drilling: 5 feet

Groundwater after drilling: ---

Date: 11/22/2010

Northing: 13,845,133.3

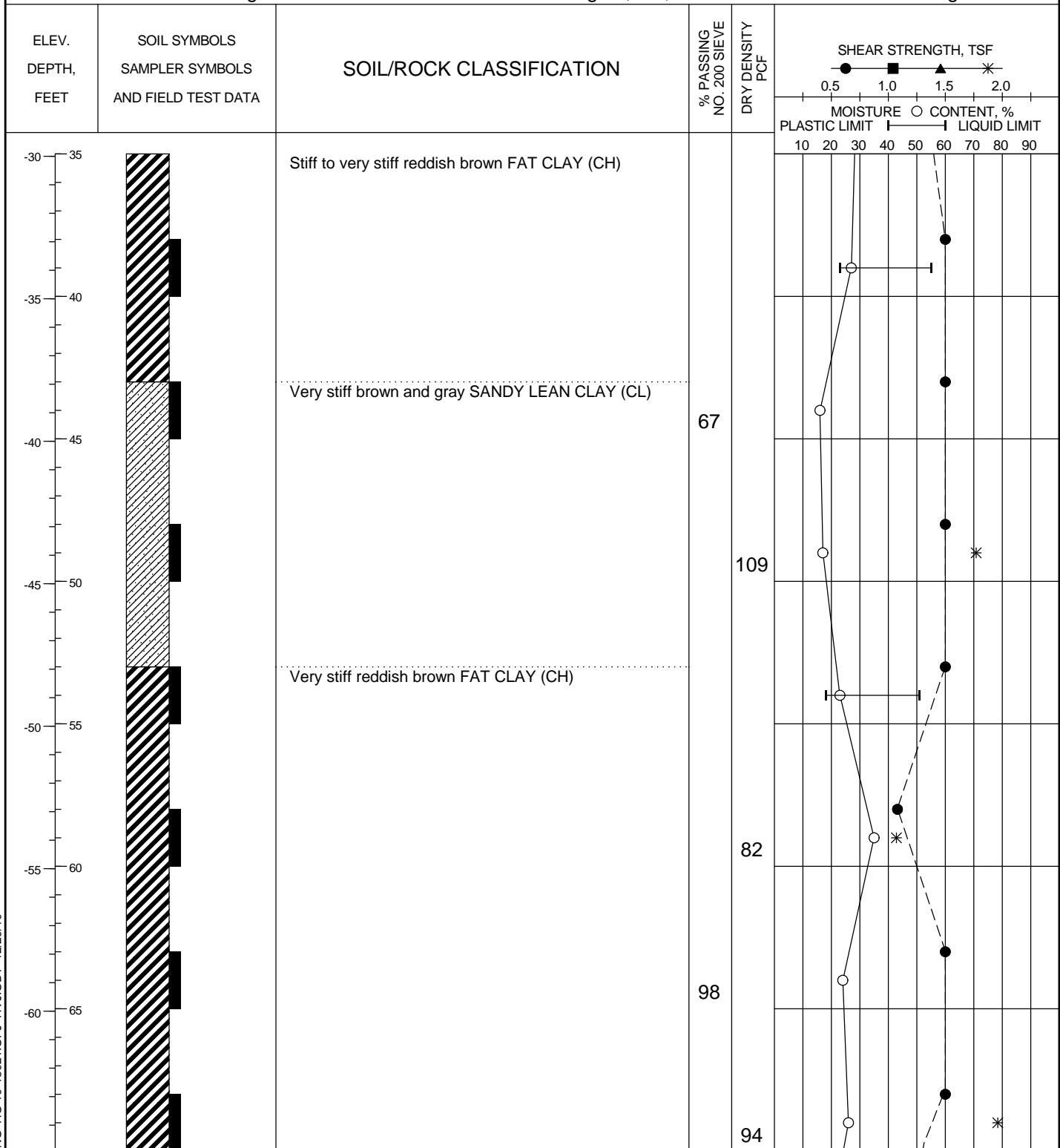
Easting: 3,209,111.9

Project No.: HG1015021

Elevation: 5.08 feet

Local Coord. Northing: 13.7

Local Coord. Easting: -787.18



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-3b

# LOG OF BORING

Project: Battleship Texas

Boring No.: B-3

Groundwater during drilling: 5 feet

Groundwater after drilling: ---

Date: 11/22/2010

Northing: 13,845,133.3

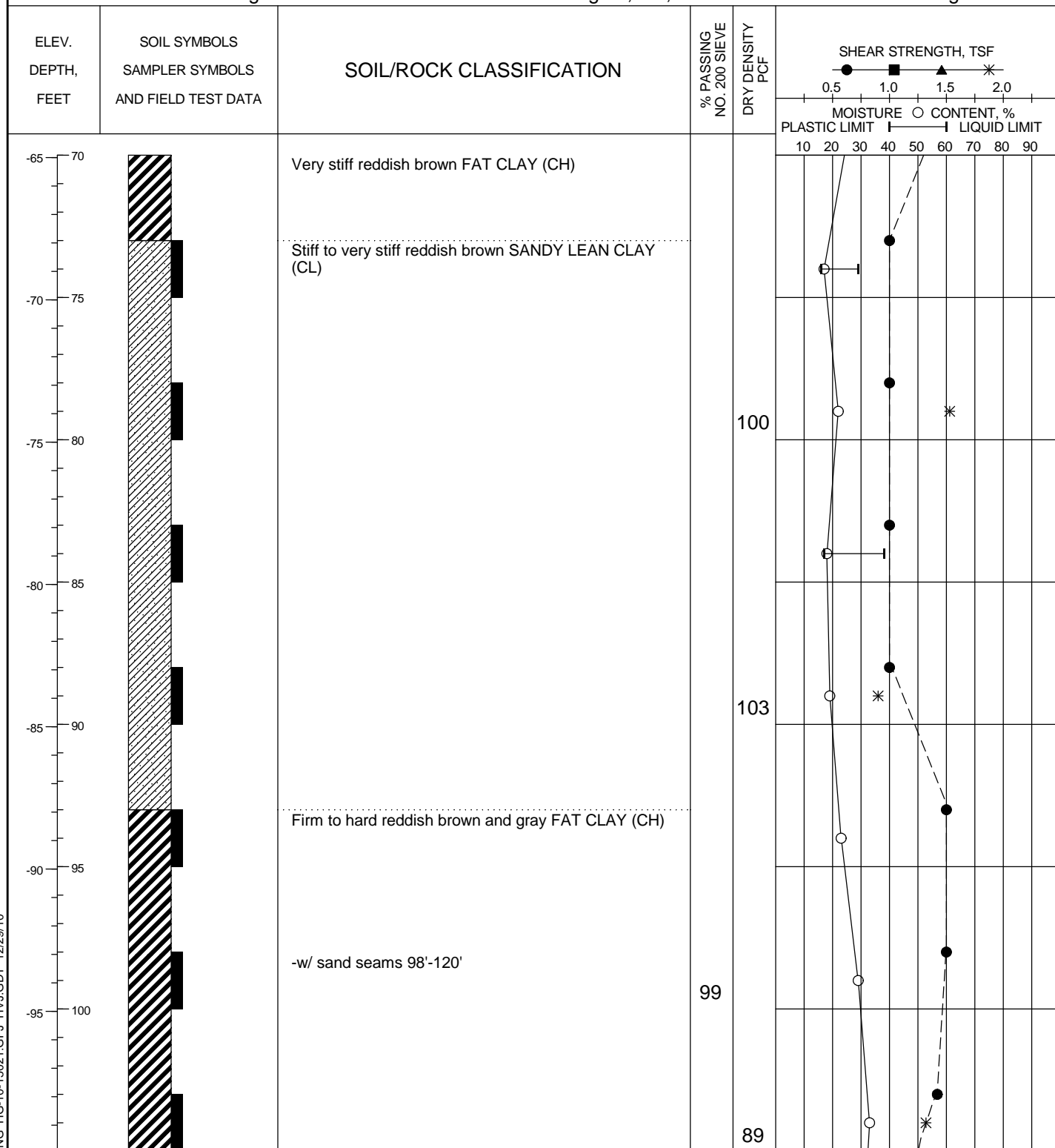
Easting: 3,209,111.9

Project No.: HG1015021

Elevation: 5.08 feet

Local Coord. Northing: 13.7

Local Coord. Easting: -787.18



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-3c

# LOG OF BORING

Project: Battleship Texas

Boring No.: B-3

Groundwater during drilling: 5 feet

Groundwater after drilling: ---

Date: 11/22/2010

Northing: 13,845,133.3

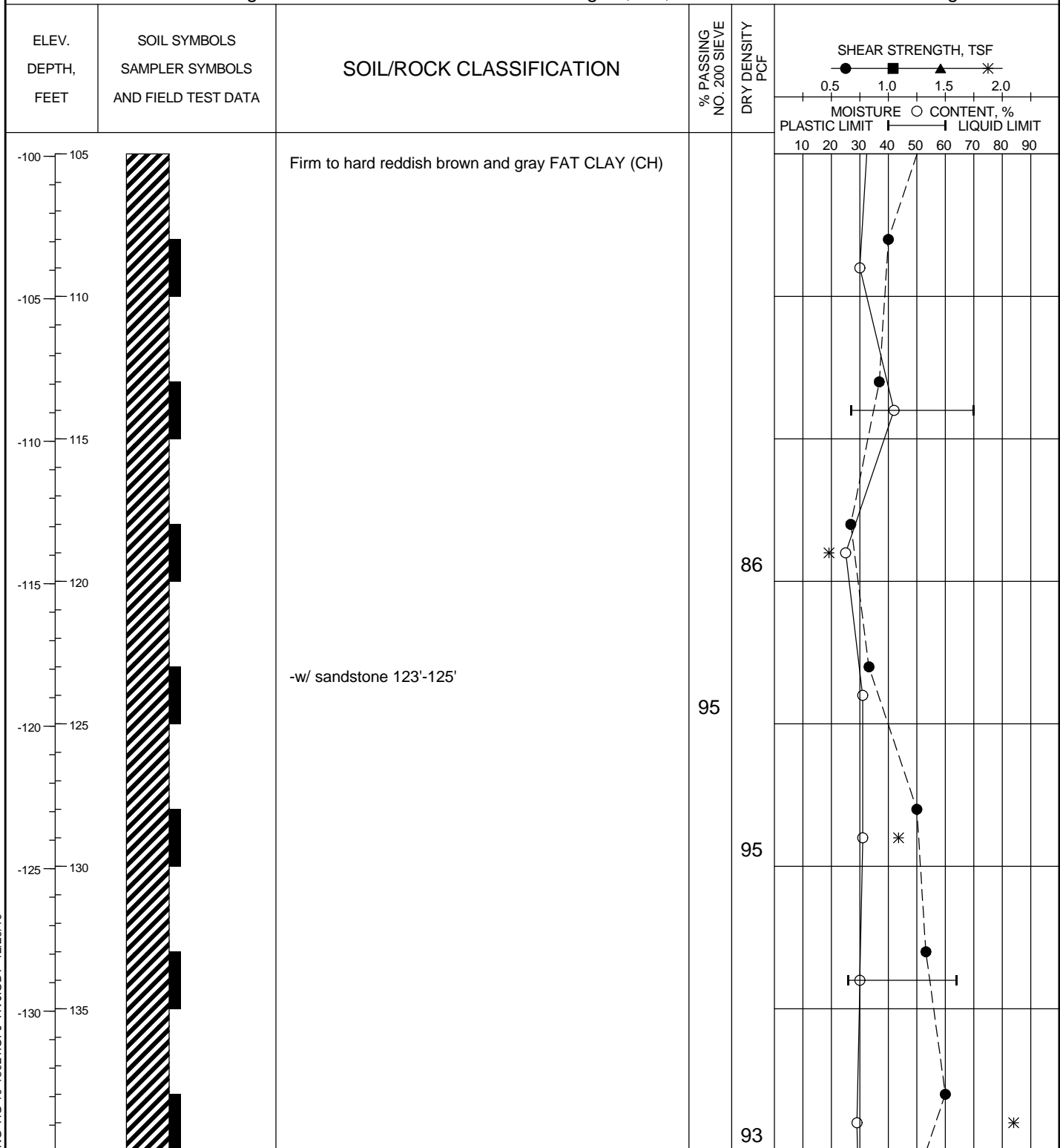
Easting: 3,209,111.9

Project No.: HG1015021

Elevation: 5.08 feet

Local Coord. Northing: 13.7

Local Coord. Easting: -787.18



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

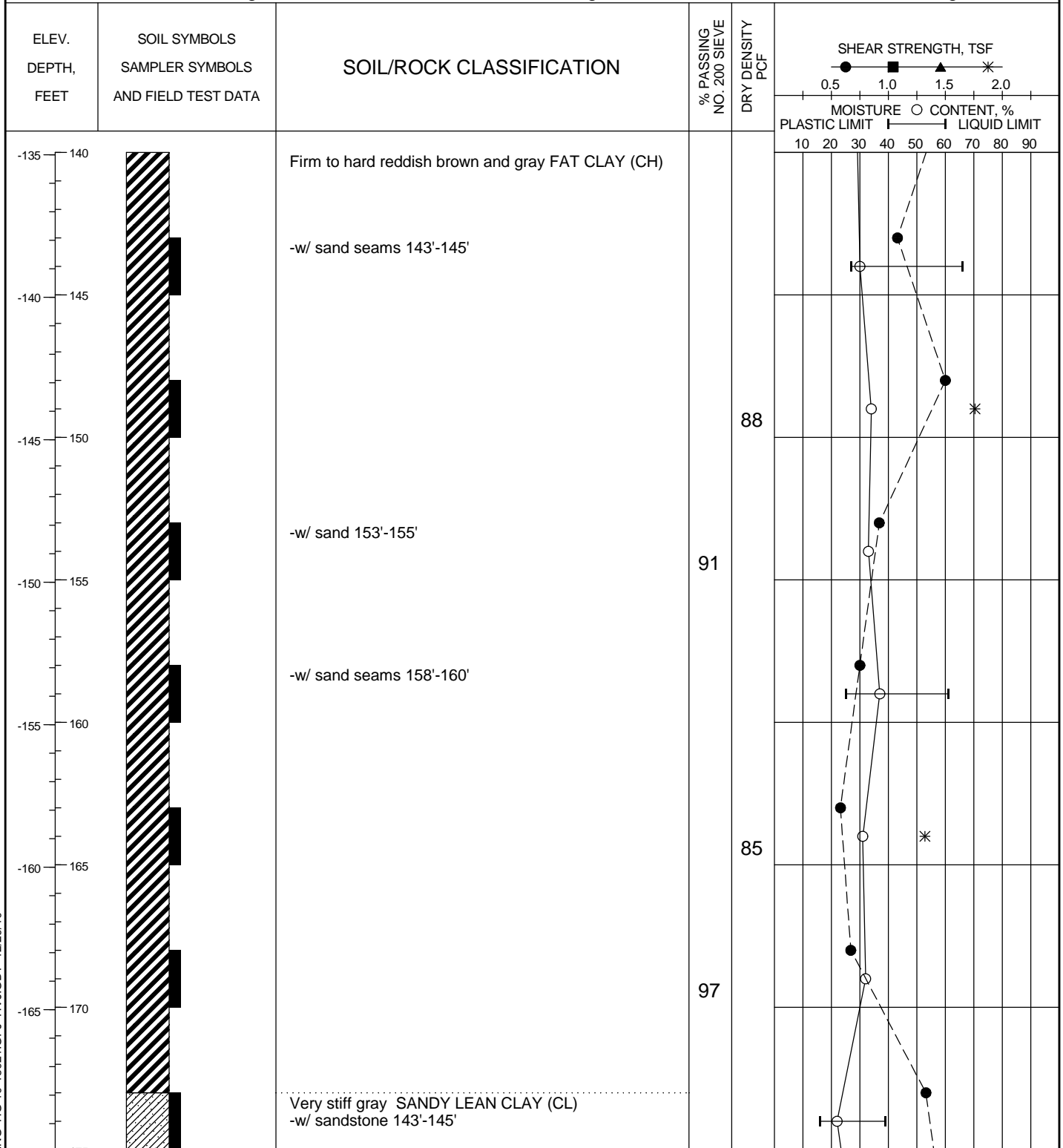
PLATE A-3d

# LOG OF BORING

Project: Battleship Texas  
 Boring No.: B-3  
 Groundwater during drilling: 5 feet  
 Groundwater after drilling: ---

Date: 11/22/2010  
 Northing: 13,845,133.3  
 Easting: 3,209,111.9

Project No.: HG1015021  
 Elevation: 5.08 feet  
 Local Coord. Northing: 13.7  
 Local Coord. Easting: -787.18



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. \* = UU Triaxial

See Plate 2 for boring location.

PLATE A-3e

LOG OF SOIL BORING HG-10-15021.GPJ HVJ.GDT 12/29/10

# LOG OF BORING

Project: Battleship Texas

Boring No.: B-3

Groundwater during drilling: 5 feet

Groundwater after drilling: ---

Date: 11/22/2010

Northing: 13,845,133.3

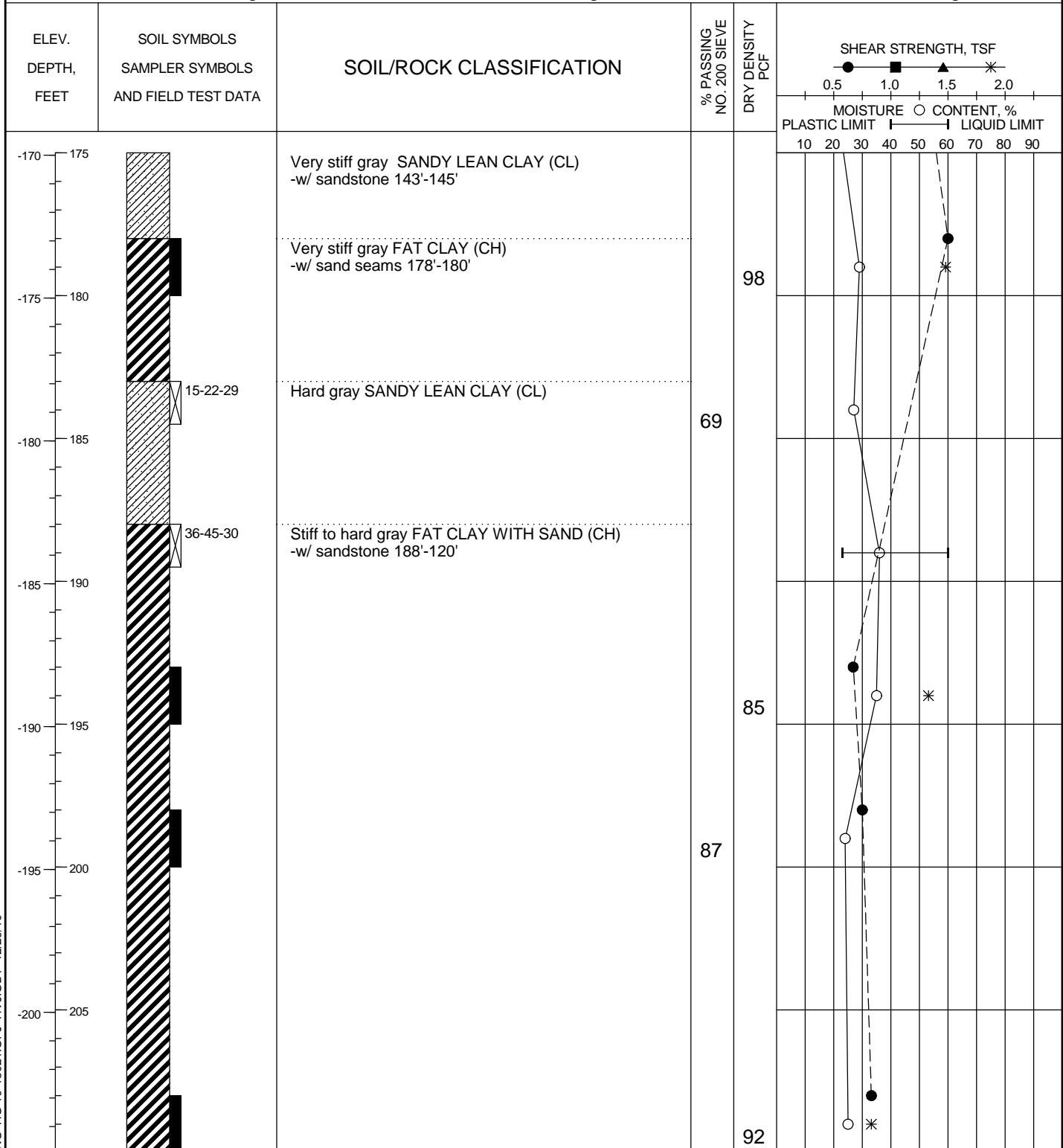
Easting: 3,209,111.9

Project No.: HG1015021

Elevation: 5.08 feet

Local Coord. Northing: 13.7

Local Coord. Easting: -787.18



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. \* = UU Triaxial

See Plate 2 for boring location.

PLATE A-3f

# LOG OF BORING

Project: Battleship Texas

Boring No.: B-3

Groundwater during drilling: 5 feet

Groundwater after drilling: ---

Date: 11/22/2010

Northing: 13,845,133.3

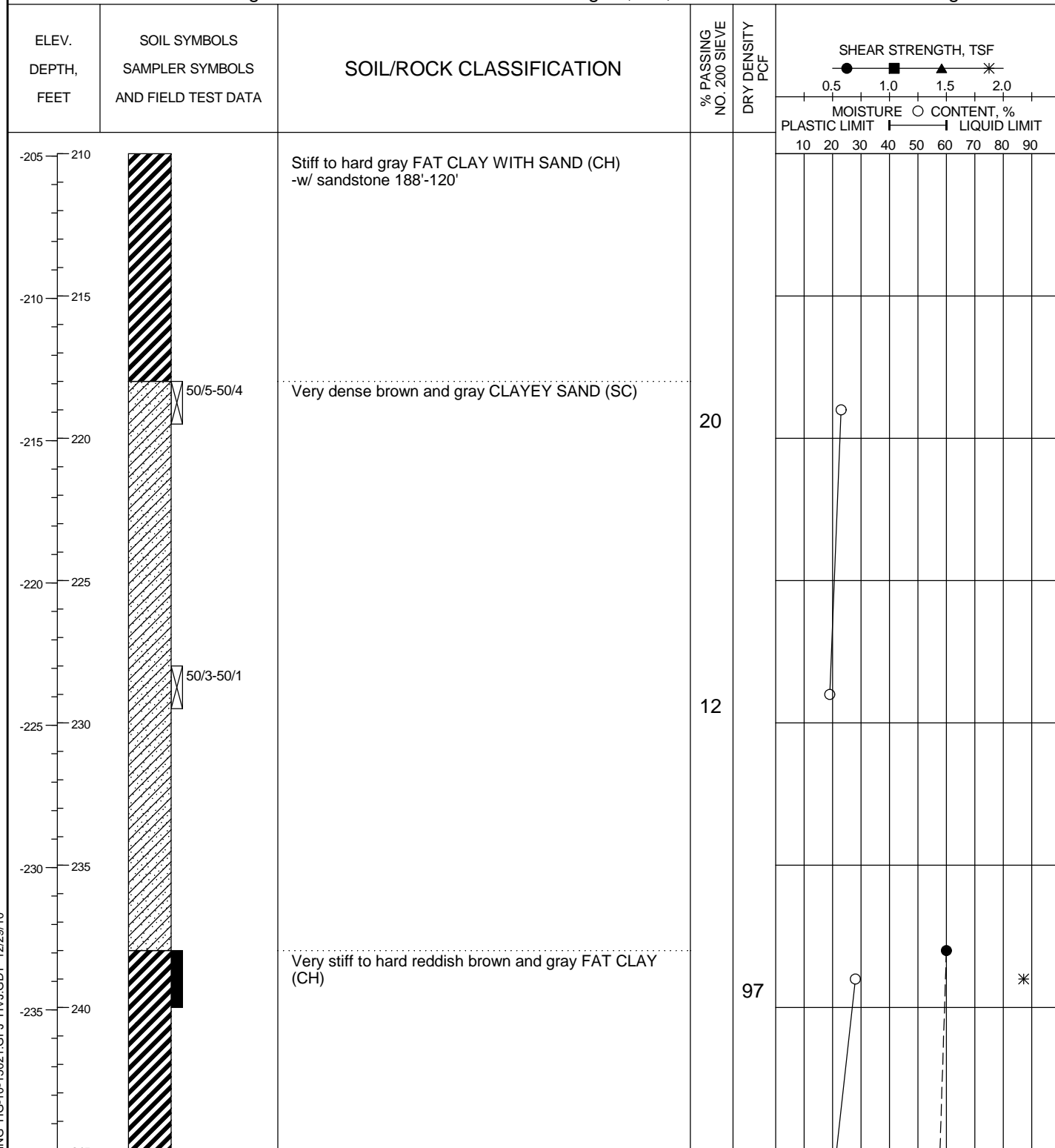
Easting: 3,209,111.9

Project No.: HG1015021

Elevation: 5.08 feet

Local Coord. Northing: 13.7

Local Coord. Easting: -787.18



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-3g



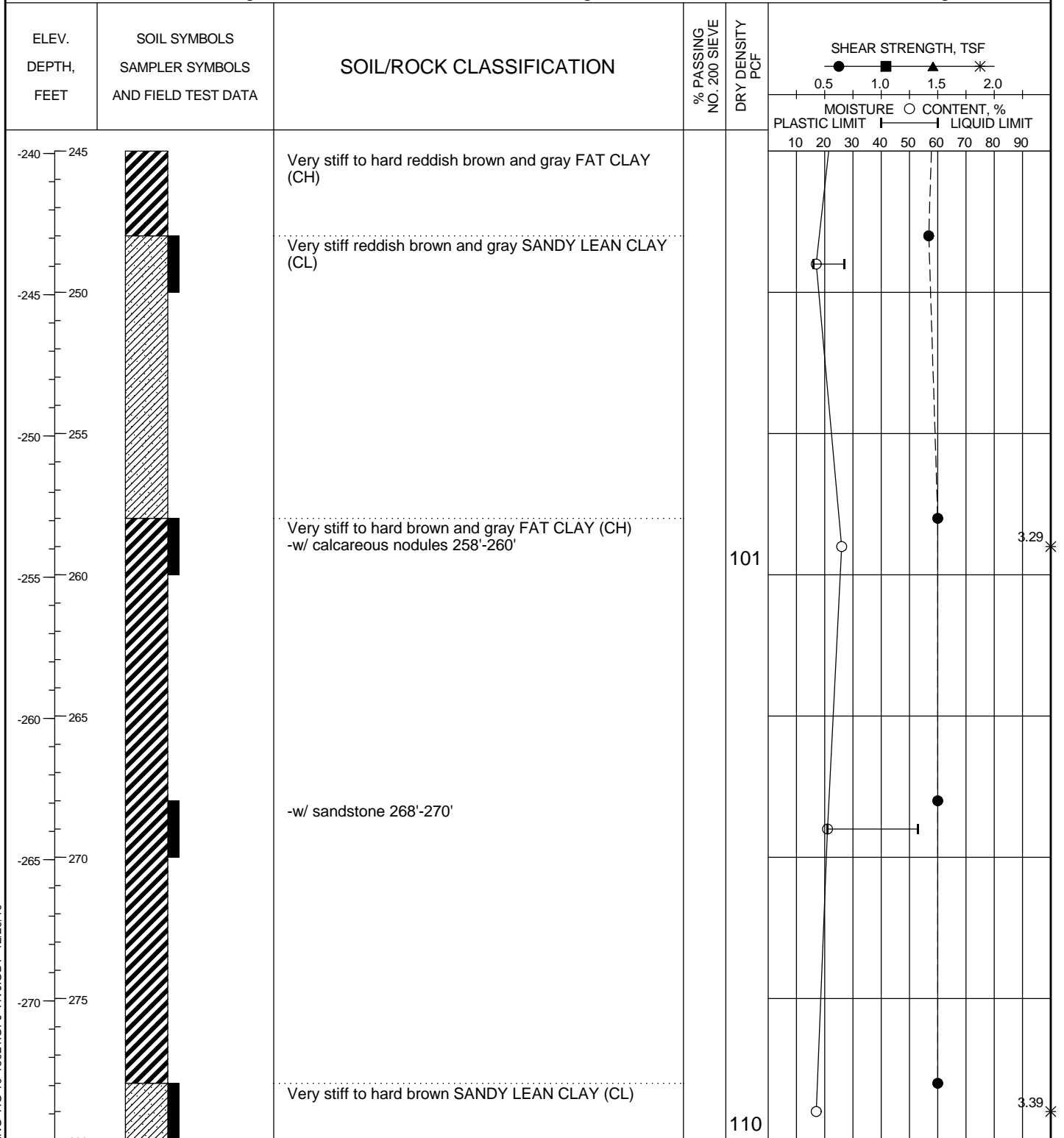
LOG OF SOIL BORING HG-10-15021.GPJ HVJ.GDT 12/29/10

# LOG OF BORING

Project: Battleship Texas  
Boring No.: B-3  
Groundwater during drilling: 5 feet  
Groundwater after drilling: ---

Date: 11/22/2010  
Northing: 13,845,133.3  
Easting: 3,209,111.9

Project No.: HG1015021  
Elevation: 5.08 feet  
Local Coord. Northing: 13.7  
Local Coord. Easting: -787.18



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. \* = UU Triaxial

See Plate 2 for boring location.

PLATE A-3h

LOG OF SOIL BORING HG-10-15021.GPJ HVJ.GDT 12/29/10

# LOG OF BORING

Project: Battleship Texas

Boring No.: B-3

Groundwater during drilling: 5 feet

Groundwater after drilling: ---

Date: 11/22/2010

Northing: 13,845,133.3

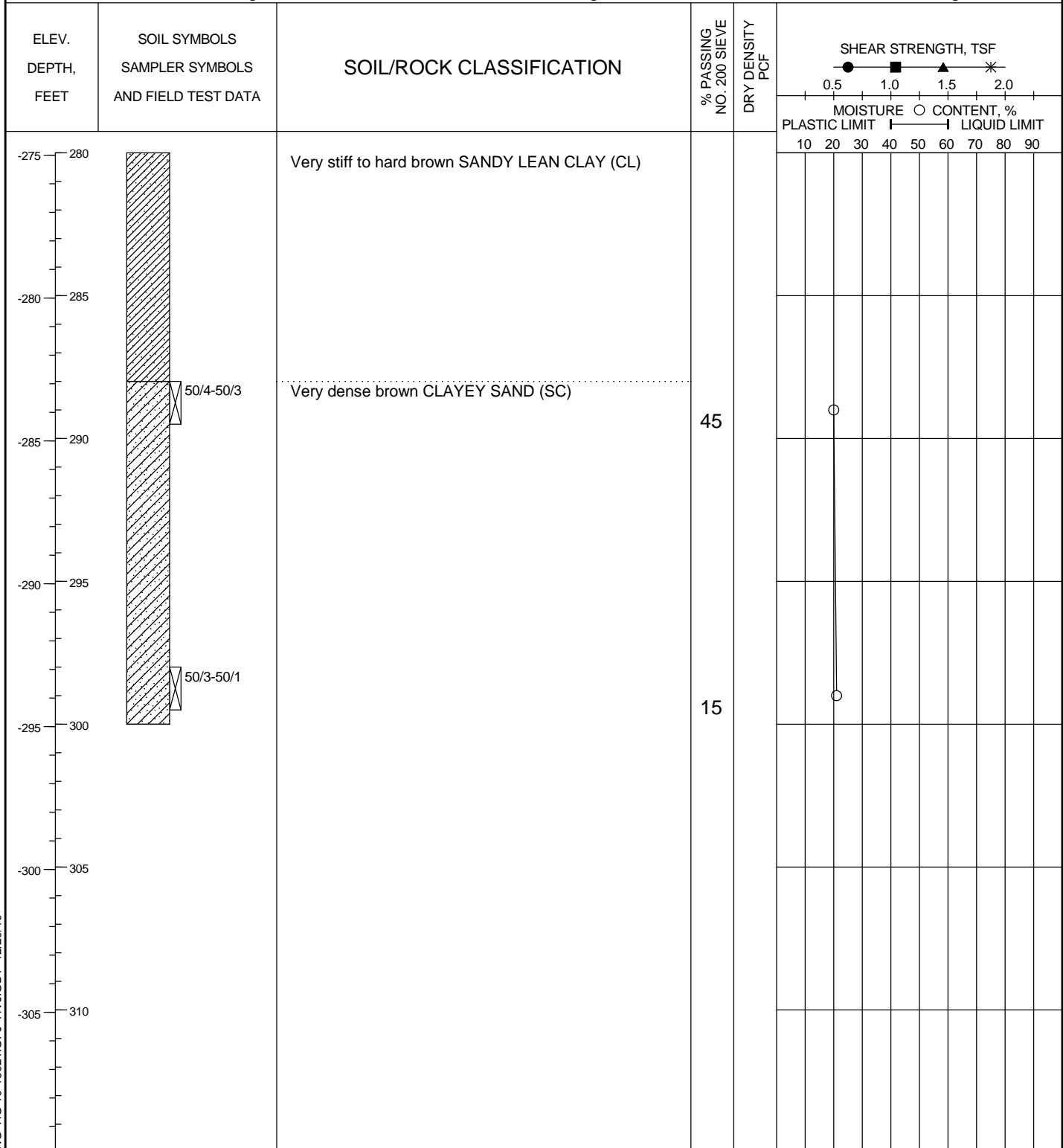
Easting: 3,209,111.9

Project No.: HG1015021

Elevation: 5.08 feet

Local Coord. Northing: 13.7

Local Coord. Easting: -787.18



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 2 for boring location.

PLATE A-3i





# LOG OF BORING

Project: Battleship Texas

Boring No.: B-4 (Depth of Water = 20 feet)

Groundwater during drilling: ---

Groundwater after drilling: ---

Date: 11/30/2010

Northing: 13,844,890.9

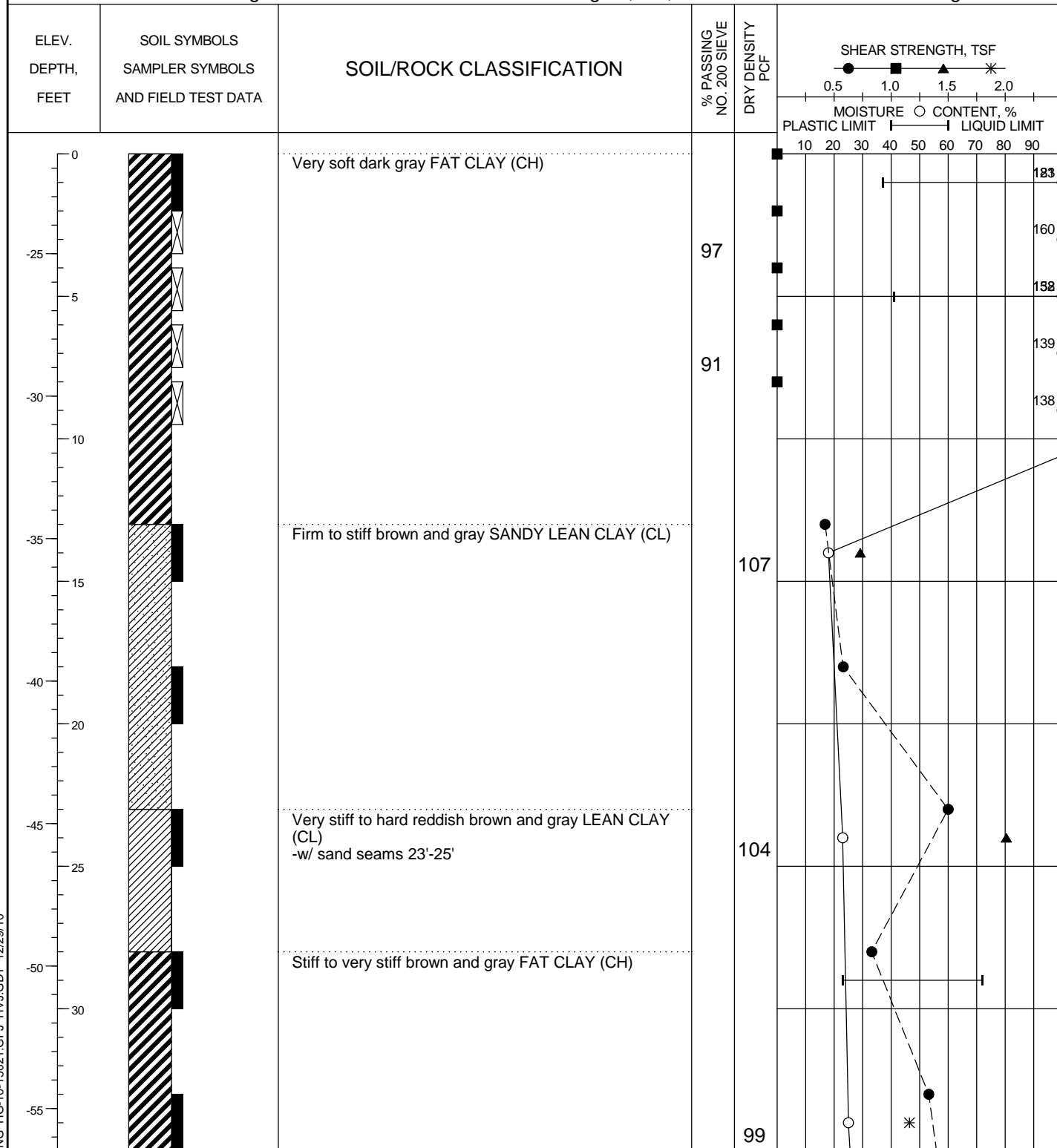
Easting: 3,209,006.2

Project No.: HG1015021

Elevation MLT: -21.50 feet

Local Coord. Northing: -242.29

Local Coord. Easting: -720.99



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-4a

# LOG OF BORING

Project: Battleship Texas

Boring No.: B-4 (Depth of Water = 20 feet)

Groundwater during drilling: ---

Groundwater after drilling: ---

Date: 11/30/2010

Northing: 13,844,890.9

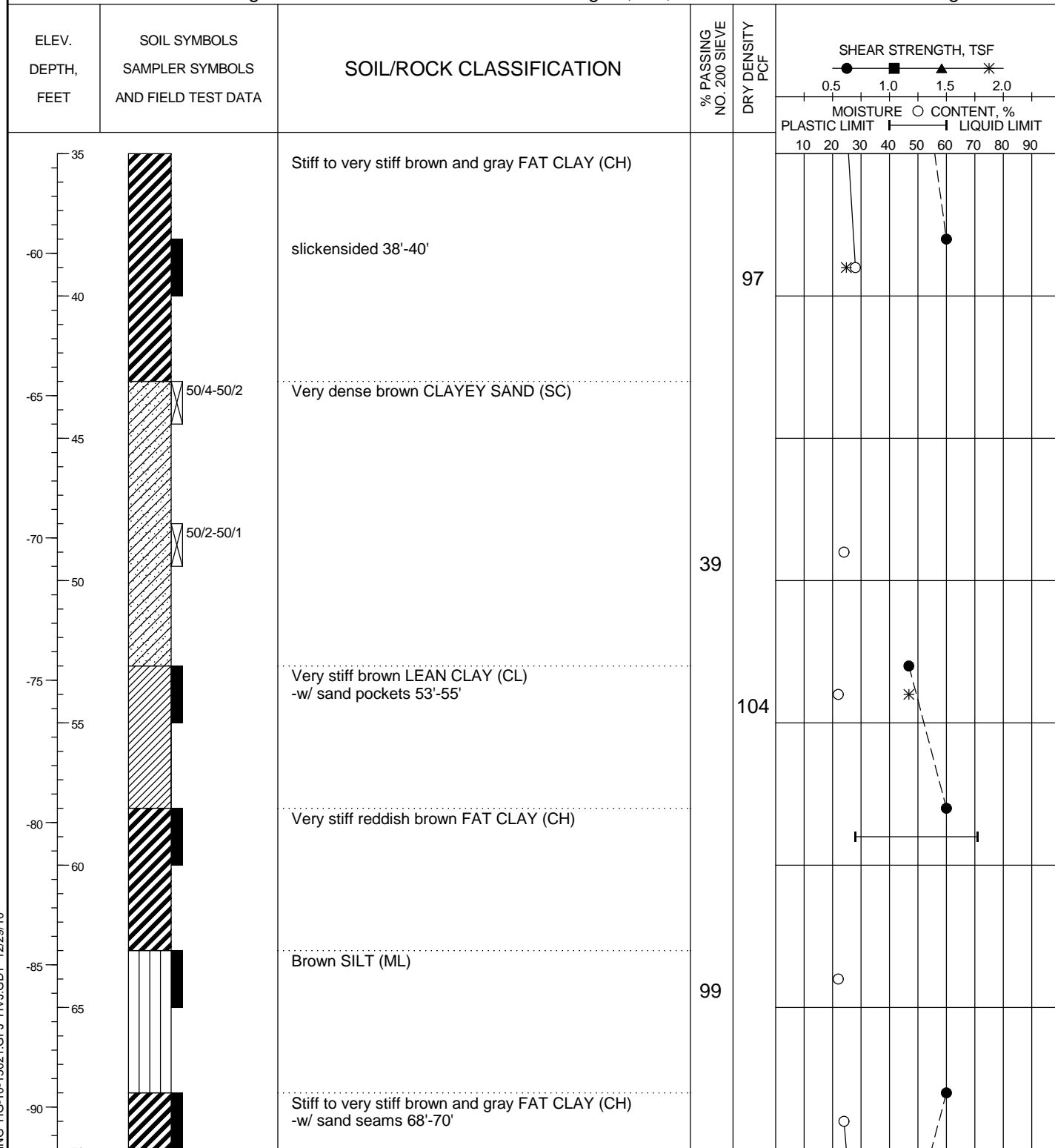
Easting: 3,209,006.2

Project No.: HG1015021

Elevation MLT: -21.50 feet

Local Coord. Northing: -242.29

Local Coord. Easting: -720.99



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-4b

LOG OF SOIL BORING HG-10-15021.GPJ HVJ.GDT 12/29/10

# LOG OF BORING

Project: Battleship Texas

Boring No.: B-4 (Depth of Water = 20 feet)

Groundwater during drilling: ---

Groundwater after drilling: ---

Date: 11/30/2010

Northing: 13,844,890.9

Easting: 3,209,006.2

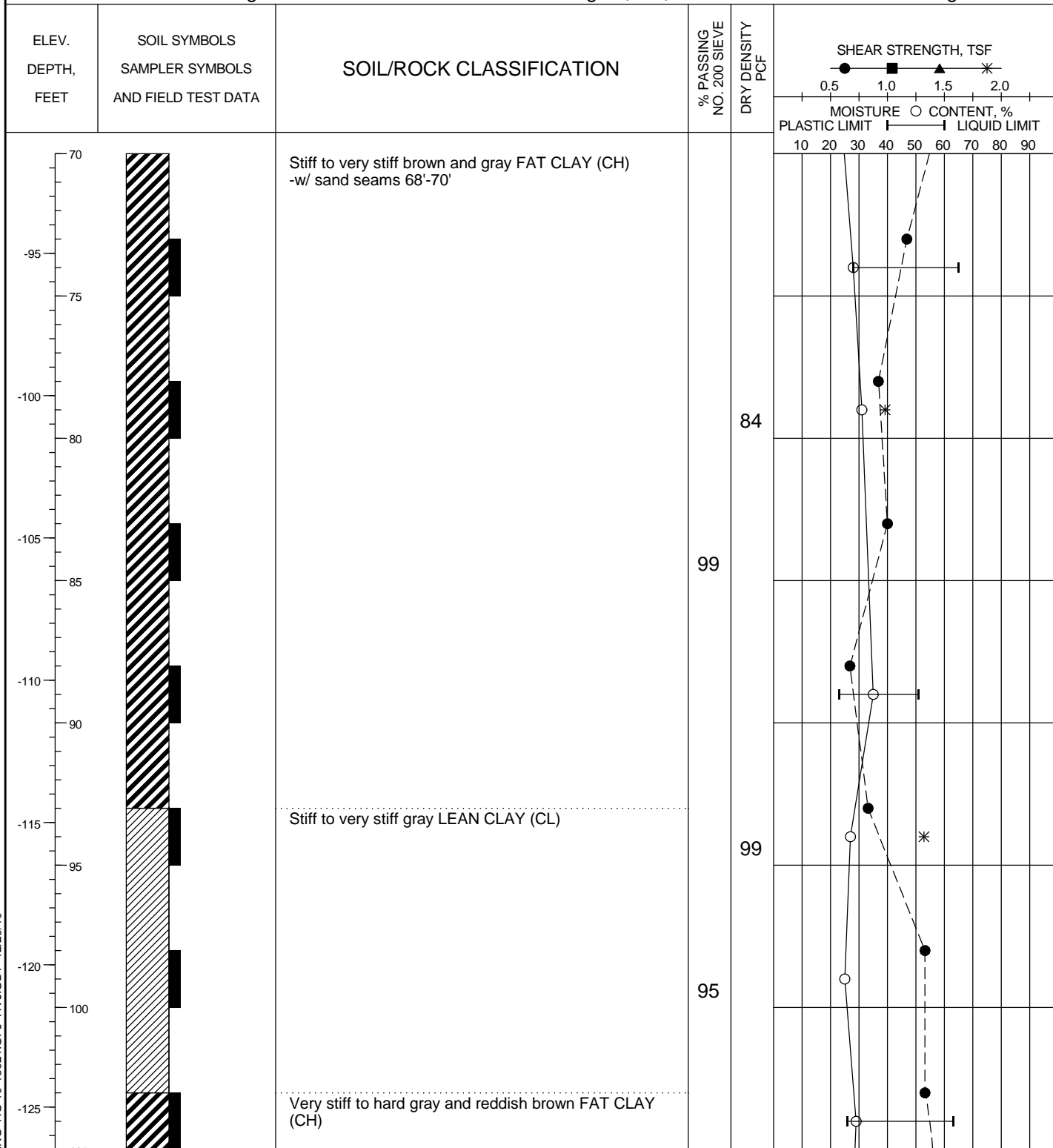
Project No.: HG1015021

Elevation MLT: -21.50 feet

Local Coord. Northing: -242.29

Local Coord. Easting: -720.99

LOG OF SOIL BORING HG-10-15021.GPJ HVJ.GDT 12/29/10



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-4c



# LOG OF BORING

Project: Battleship Texas

Boring No.: B-4 (Depth of Water = 20 feet)

Groundwater during drilling: ---

Groundwater after drilling: ---

Date: 11/30/2010

Northing: 13,844,890.9

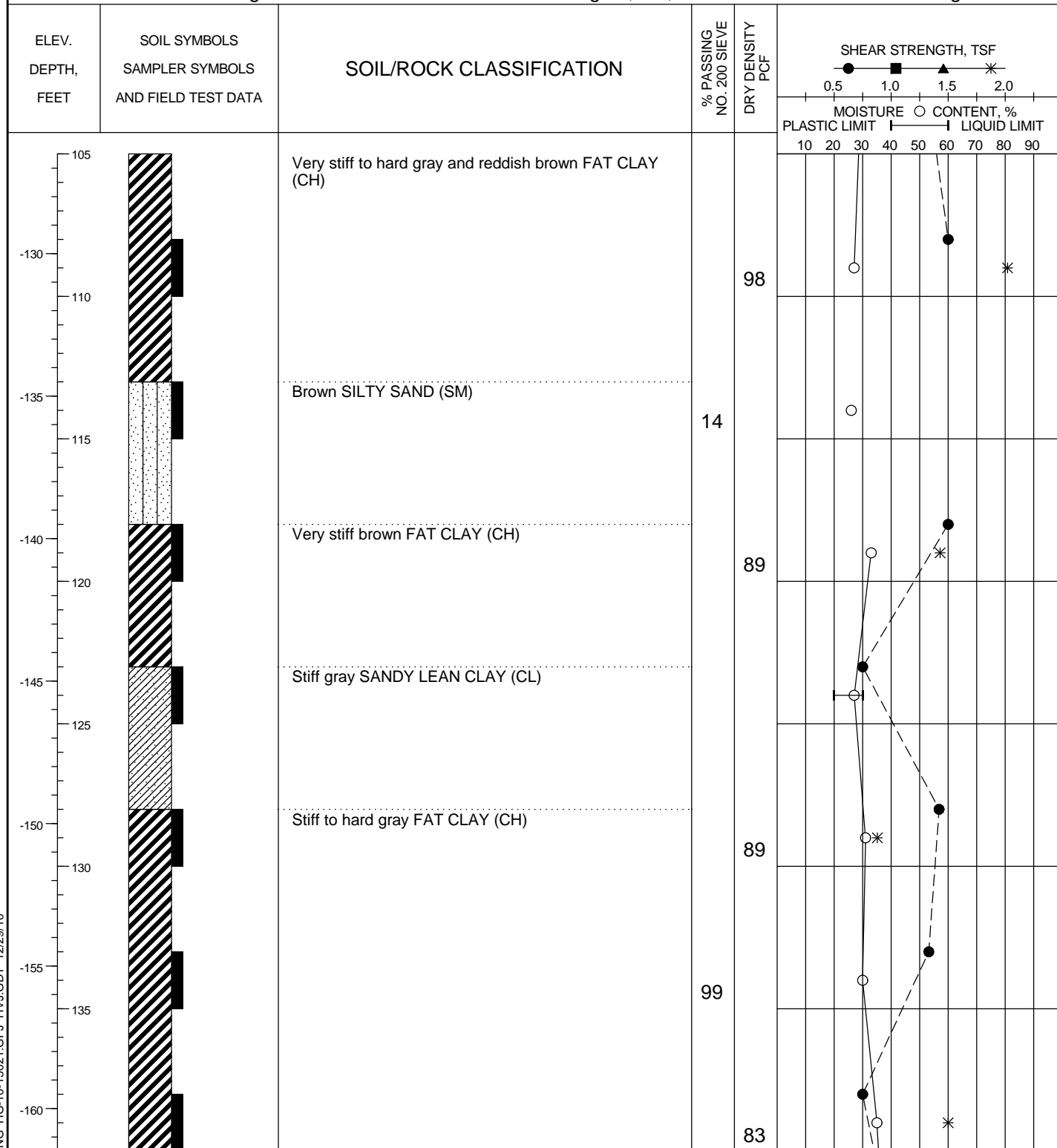
Easting: 3,209,006.2

Project No.: HG1015021

Elevation MLT: -21.50 feet

Local Coord. Northing: -242.29

Local Coord. Easting: -720.99



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-4d

# LOG OF BORING

Project: Battleship Texas

Boring No.: B-4 (Depth of Water = 20 feet)

Groundwater during drilling: ---

Groundwater after drilling: ---

Date: 11/30/2010

Northing: 13,844,890.9

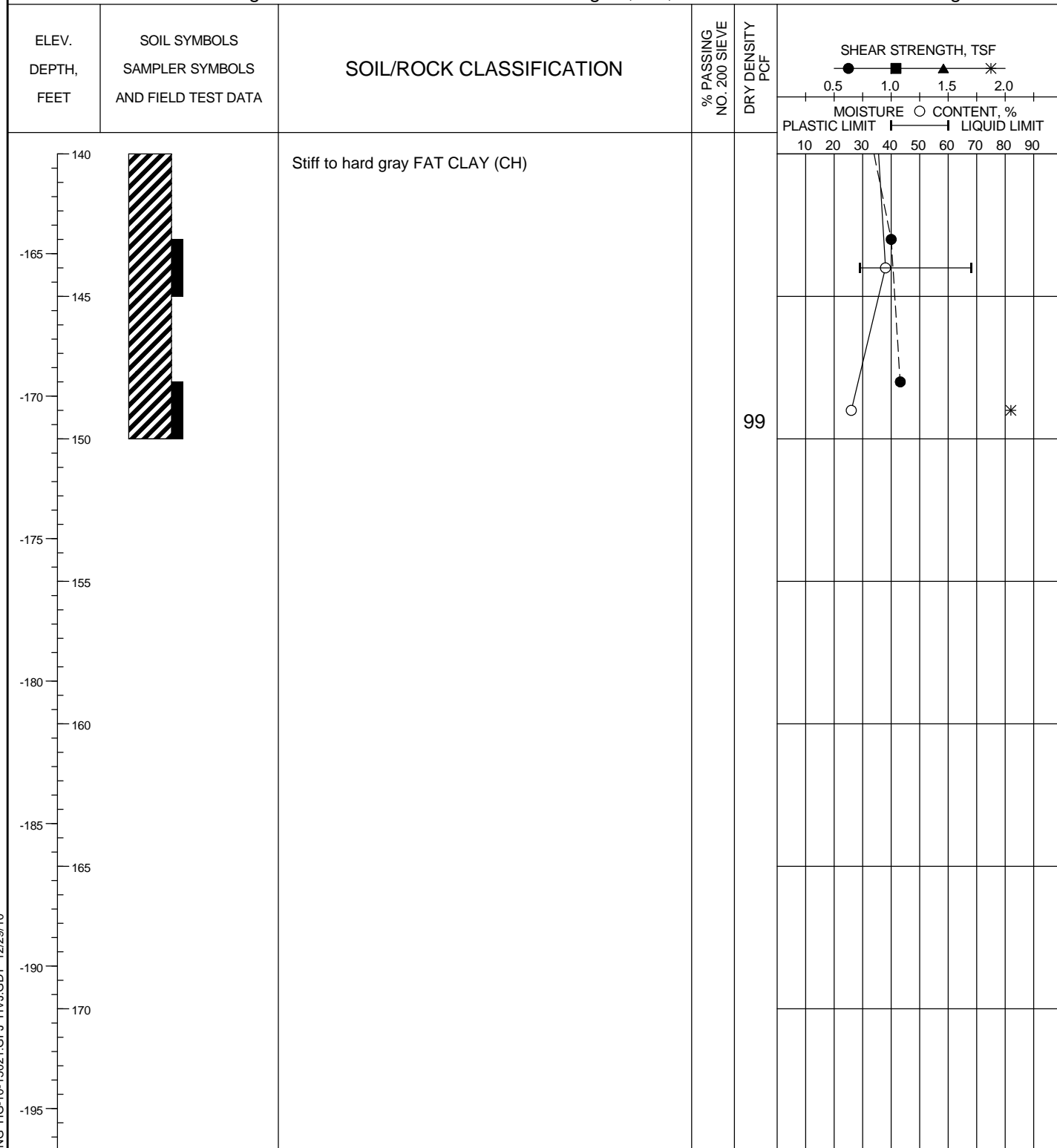
Easting: 3,209,006.2

Project No.: HG1015021

Elevation MLT: -21.50 feet

Local Coord. Northing: -242.29

Local Coord. Easting: -720.99



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-4e



LOG OF SOIL BORING HG-10-15021.GPJ HVJ.GDT 12/29/10

# LOG OF BORING

Project: Battleship Texas

Boring No.: B-5 (Depth of Water = 17 feet)

Groundwater during drilling: ---

Groundwater after drilling: ---

Date: 12/4/2010

Northing: 13,844,706.5

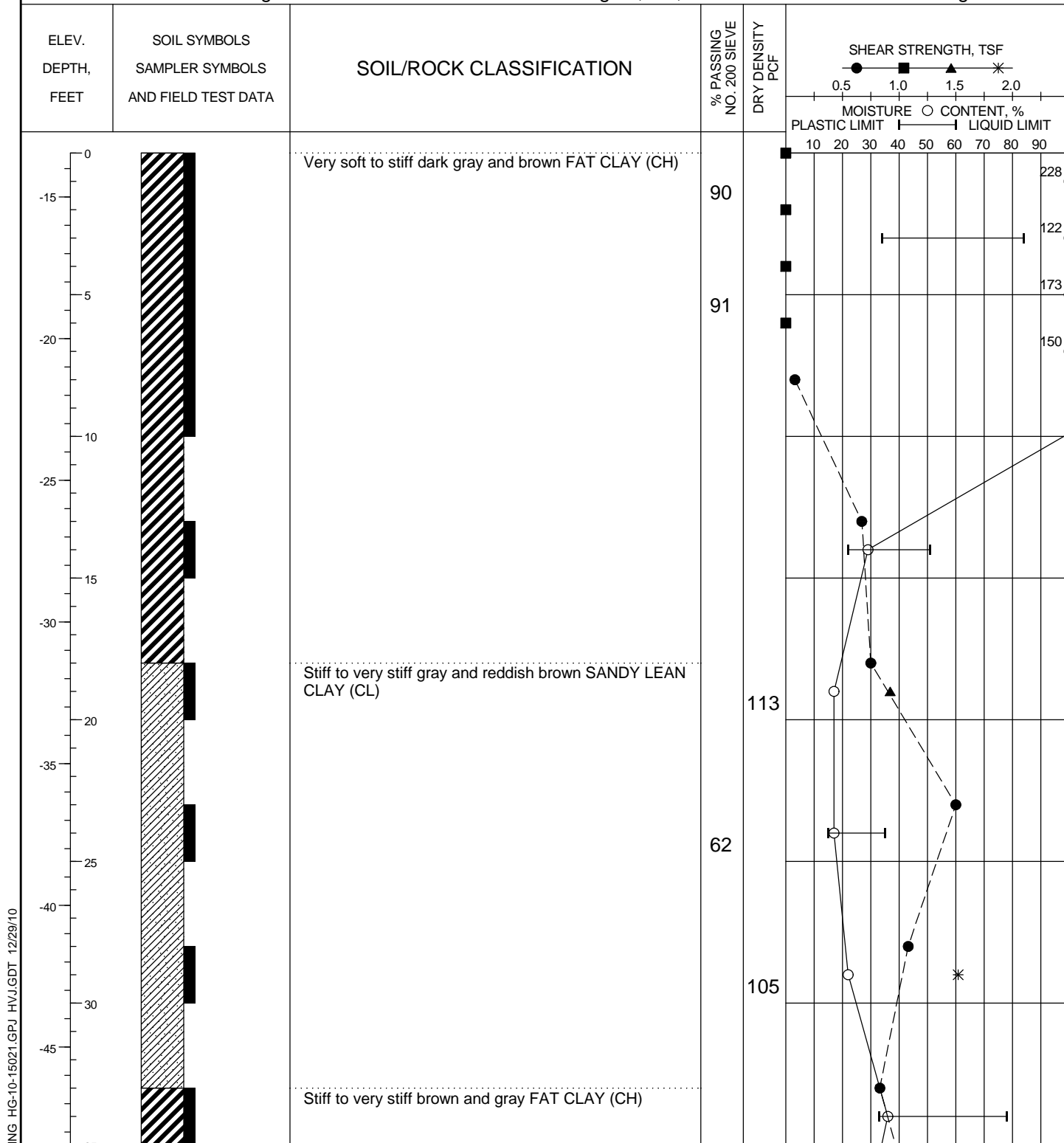
Easting: 3,209,478.0

Project No.: HG1015021

Elevation MLT: -13.45 feet

Local Coord. Northing: -96.55

Local Coord. Easting: -235.84



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-5a

LOG OF SOIL BORING HG-10-15021.GPJ HVJ.GDT 12/29/10

# LOG OF BORING

Project: Battleship Texas

Boring No.: B-5 (Depth of Water = 17 feet)

Groundwater during drilling: ---

Groundwater after drilling: ---

Date: 12/4/2010

Northing: 13,844,706.5

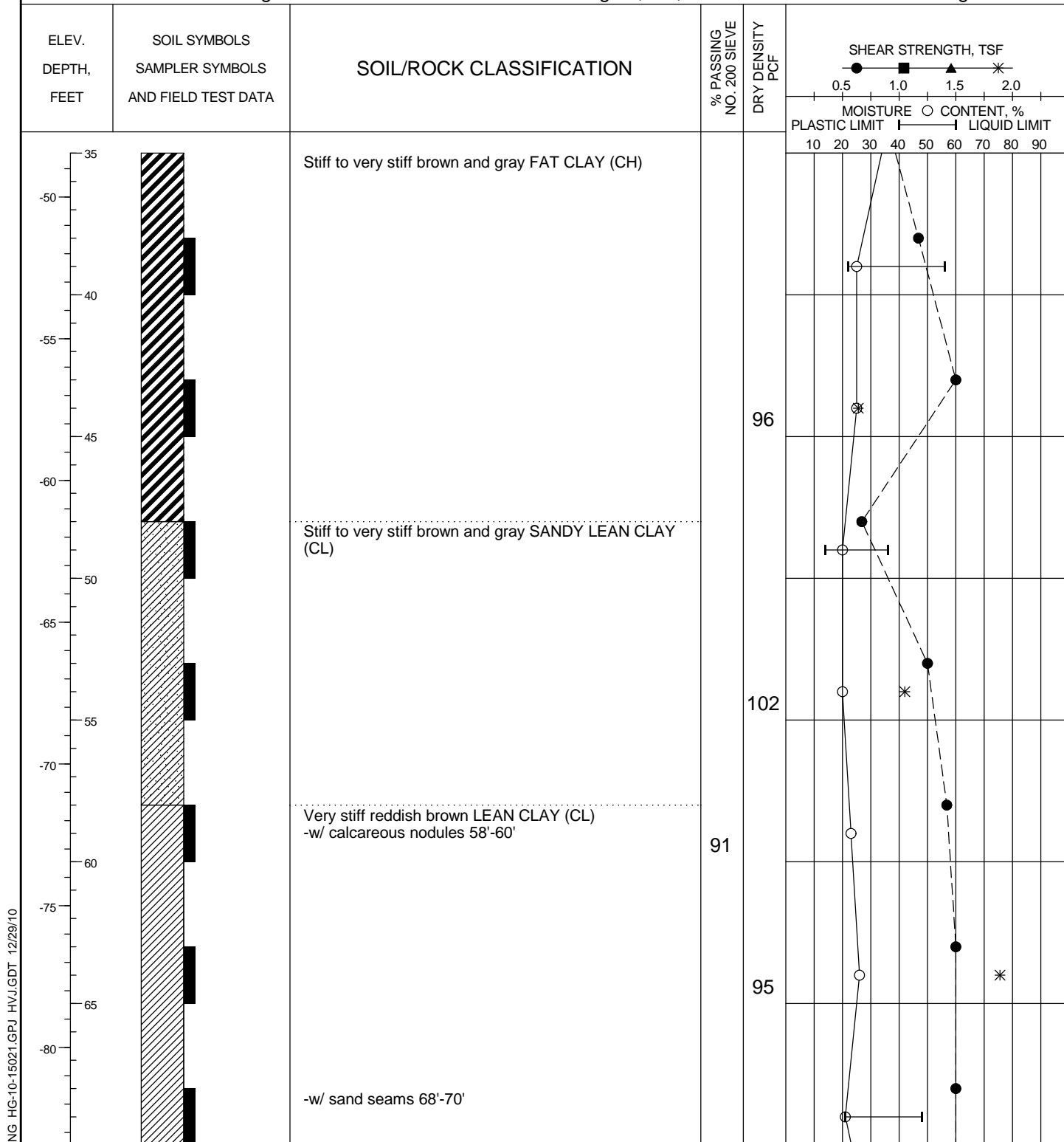
Easting: 3,209,478.0

Project No.: HG1015021

Elevation MLT: -13.45 feet

Local Coord. Northing: -96.55

Local Coord. Easting: -235.84



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-5b

# LOG OF BORING

Project: Battleship Texas

Boring No.: B-5 (Depth of Water = 17 feet)

Groundwater during drilling: ---

Groundwater after drilling: ---

Date: 12/4/2010

Northing: 13,844,706.5

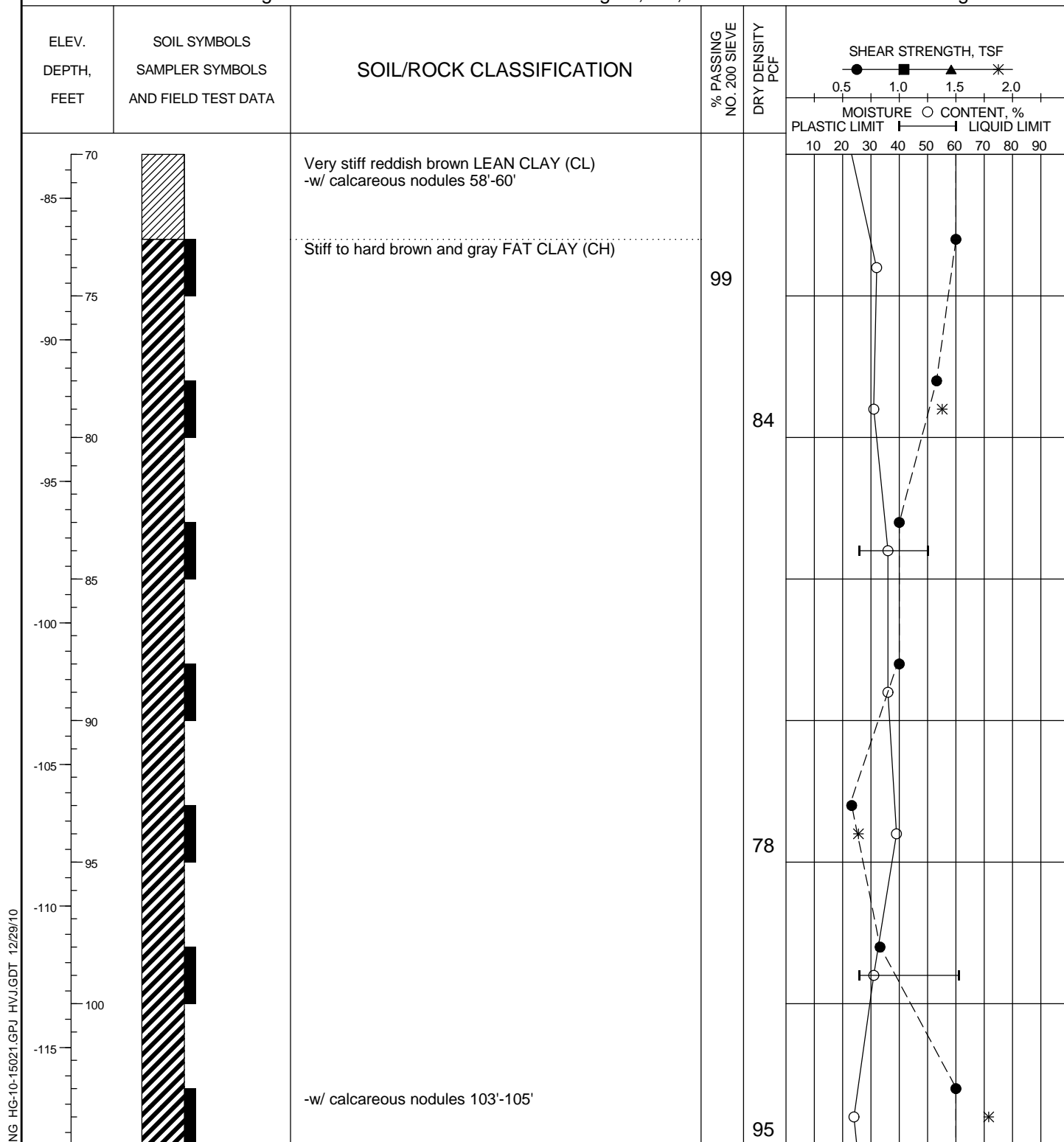
Easting: 3,209,478.0

Project No.: HG1015021

Elevation MLT: -13.45 feet

Local Coord. Northing: -96.55

Local Coord. Easting: -235.84



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-5c



# LOG OF BORING

Project: Battleship Texas

Boring No.: B-5 (Depth of Water = 17 feet)

Groundwater during drilling: ---

Groundwater after drilling: ---

Date: 12/4/2010

Northing: 13,844,706.5

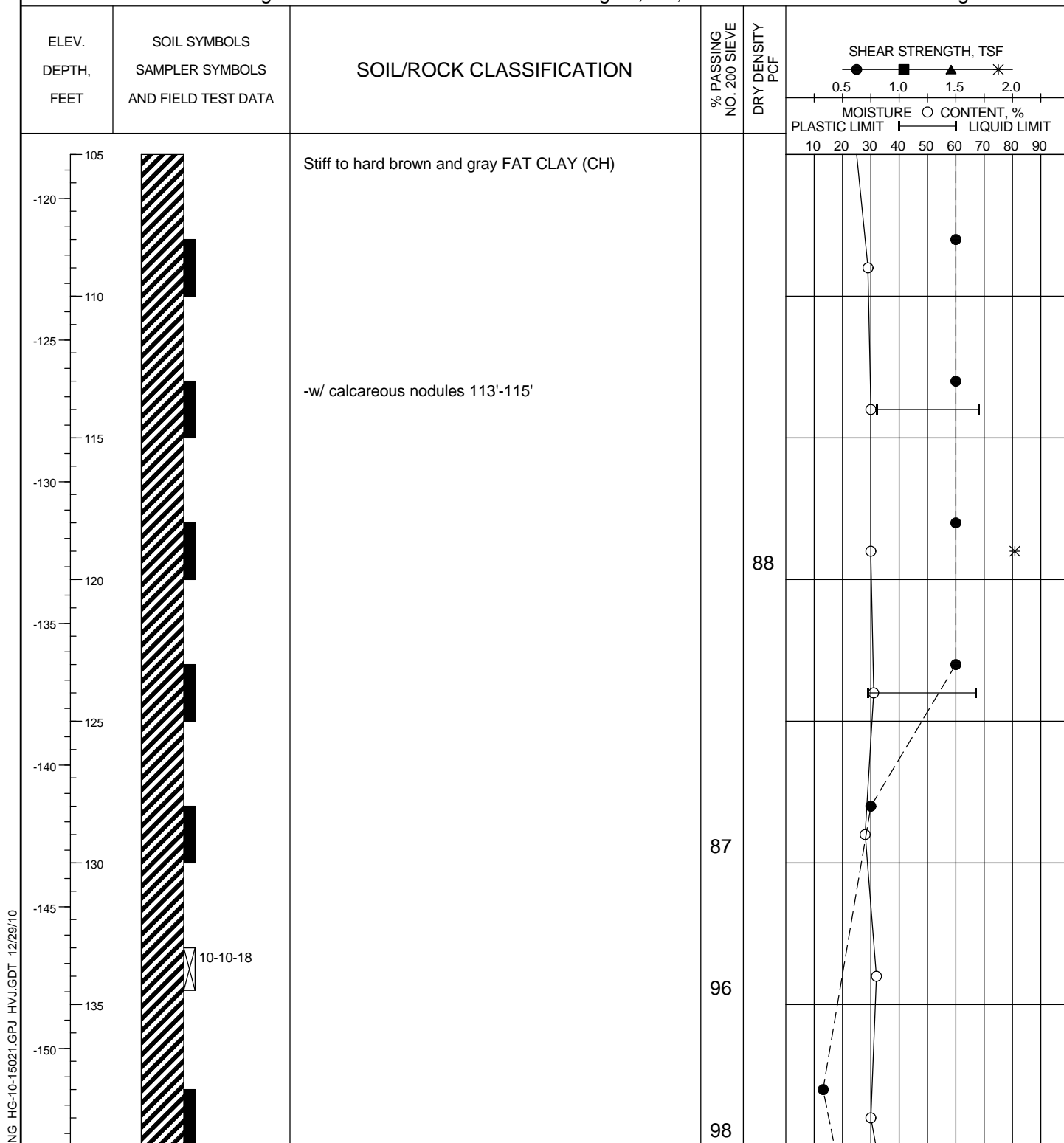
Easting: 3,209,478.0

Project No.: HG1015021

Elevation MLT: -13.45 feet

Local Coord. Northing: -96.55

Local Coord. Easting: -235.84



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-5d

# LOG OF BORING

Project: Battleship Texas

Boring No.: B-5 (Depth of Water = 17 feet)

Groundwater during drilling: ---

Groundwater after drilling: ---

Date: 12/4/2010

Northing: 13,844,706.5

Easting: 3,209,478.0

Project No.: HG1015021

Elevation MLT: -13.45 feet

Local Coord. Northing: -96.55

Local Coord. Easting: -235.84

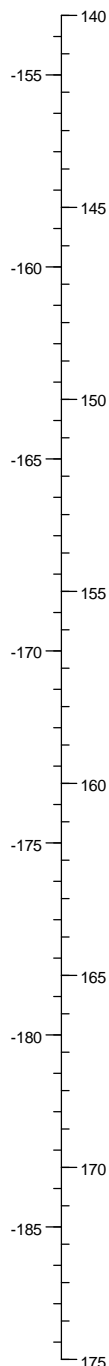
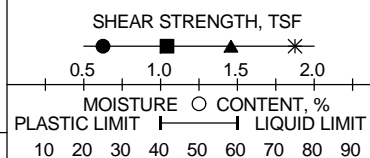
ELEV.  
DEPTH,  
FEET

SOIL SYMBOLS  
SAMPLER SYMBOLS  
AND FIELD TEST DATA

SOIL/ROCK CLASSIFICATION

% PASSING  
NO. 200 SIEVE

DRY DENSITY  
PCF



Stiff to hard brown and gray FAT CLAY (CH)

78

Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-5e



LOG OF SOIL BORING HG-10-15021.GPJ HVJ.GDT 12/29/10

# LOG OF BORING

Project: Battleship Texas

Boring No.: B-6 (Depth of Water = 16.5 feet)

Groundwater during drilling: ---

Groundwater after drilling: ---

Date: 11/17/2010

Northing: 13,844,509.5

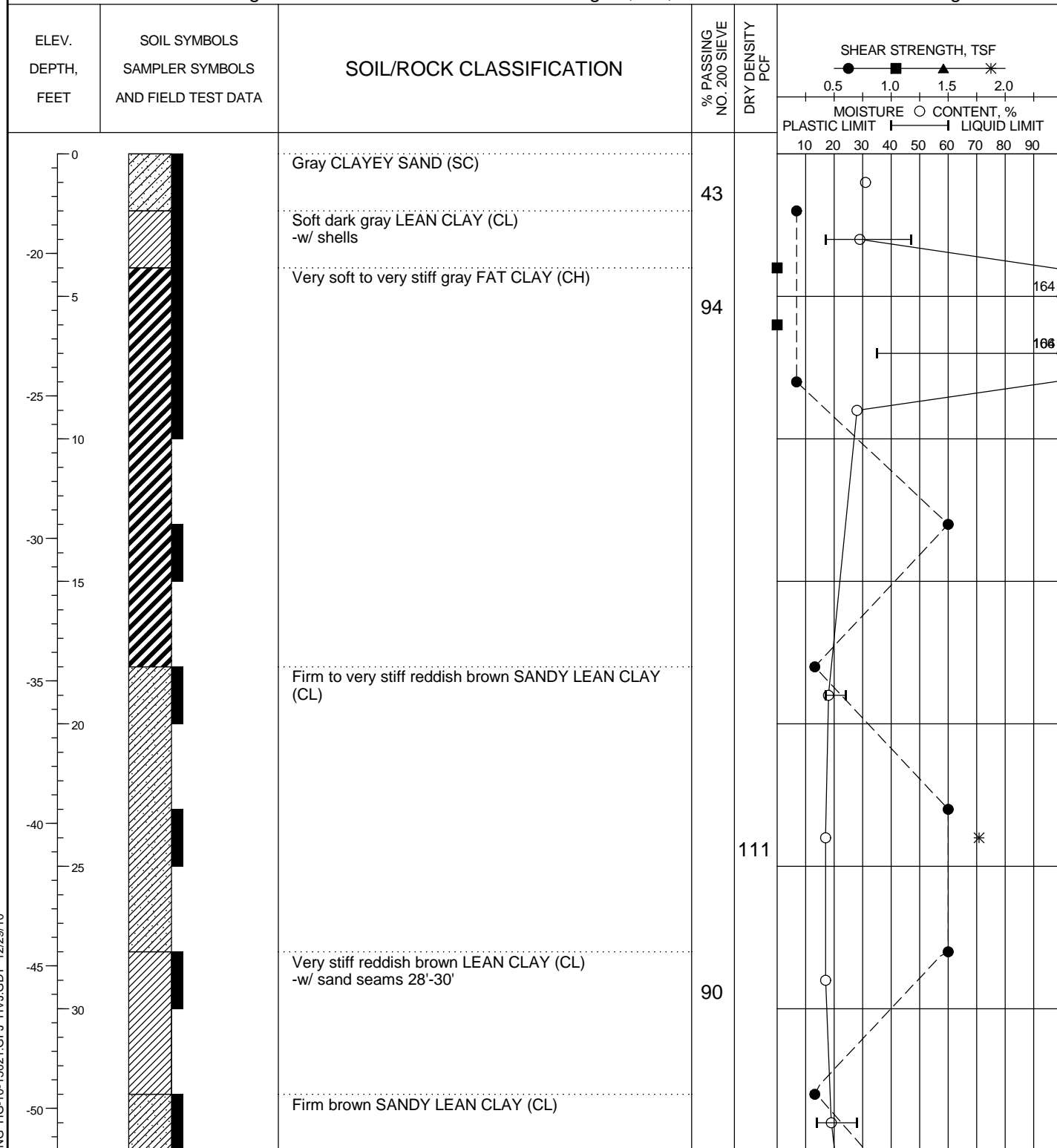
Easting: 3,209,569.3

Project No.: HG1015021

Elevation MLT: -16.51 feet

Local Coord. Northing: -195.46

Local Coord. Easting: -42.49



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-6a

# LOG OF BORING

Project: Battleship Texas

Boring No.: B-6 (Depth of Water = 16.5 feet)

Groundwater during drilling: ---

Groundwater after drilling: ---

Date: 11/17/2010

Northing: 13,844,509.5

Easting: 3,209,569.3

Project No.: HG1015021

Elevation MLT: -16.51 feet

Local Coord. Northing: -195.46

Local Coord. Easting: -42.49

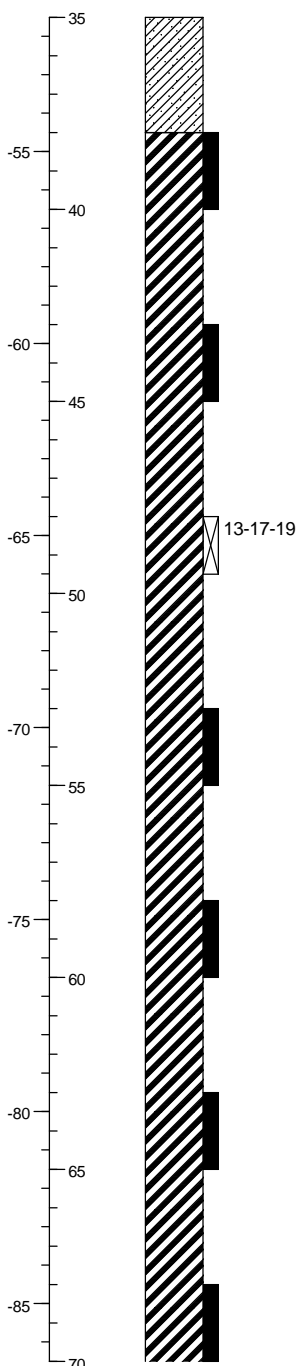
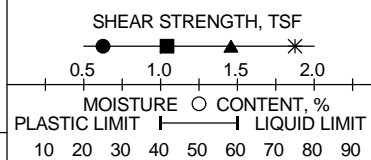
ELEV.  
DEPTH,  
FEET

SOIL SYMBOLS  
SAMPLER SYMBOLS  
AND FIELD TEST DATA

SOIL/ROCK CLASSIFICATION

% PASSING  
NO. 200 SIEVE

DRY DENSITY  
PCF



Firm brown SANDY LEAN CLAY (CL)

Stiff to hard reddish brown and gray FAT CLAY (CH)

94

97

106

Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-6b



# LOG OF BORING

Project: Battleship Texas

Boring No.: B-6 (Depth of Water = 16.5 feet)

Groundwater during drilling: ---

Groundwater after drilling: ---

Date: 11/17/2010

Northing: 13,844,509.5

Easting: 3,209,569.3

Project No.: HG1015021

Elevation MLT: -16.51 feet

Local Coord. Northing: -195.46

Local Coord. Easting: -42.49

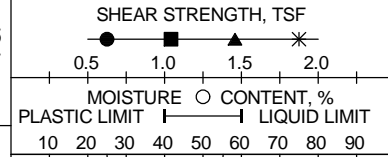
ELEV.  
DEPTH,  
FEET

SOIL SYMBOLS  
SAMPLER SYMBOLS  
AND FIELD TEST DATA

SOIL/ROCK CLASSIFICATION

% PASSING  
NO. 200 SIEVE

DRY DENSITY  
PCF



Stiff to hard reddish brown and gray FAT CLAY (CH)

-w/ calcareous nodules 103'-105'

Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-6c



LOG OF SOIL BORING HG-10-15021.GPJ HVJ.GDT 12/29/10

# LOG OF BORING

Project: Battleship Texas

Boring No.: B-6 (Depth of Water = 16.5 feet)

Groundwater during drilling: ---

Groundwater after drilling: ---

Date: 11/17/2010

Northing: 13,844,509.5

Easting: 3,209,569.3

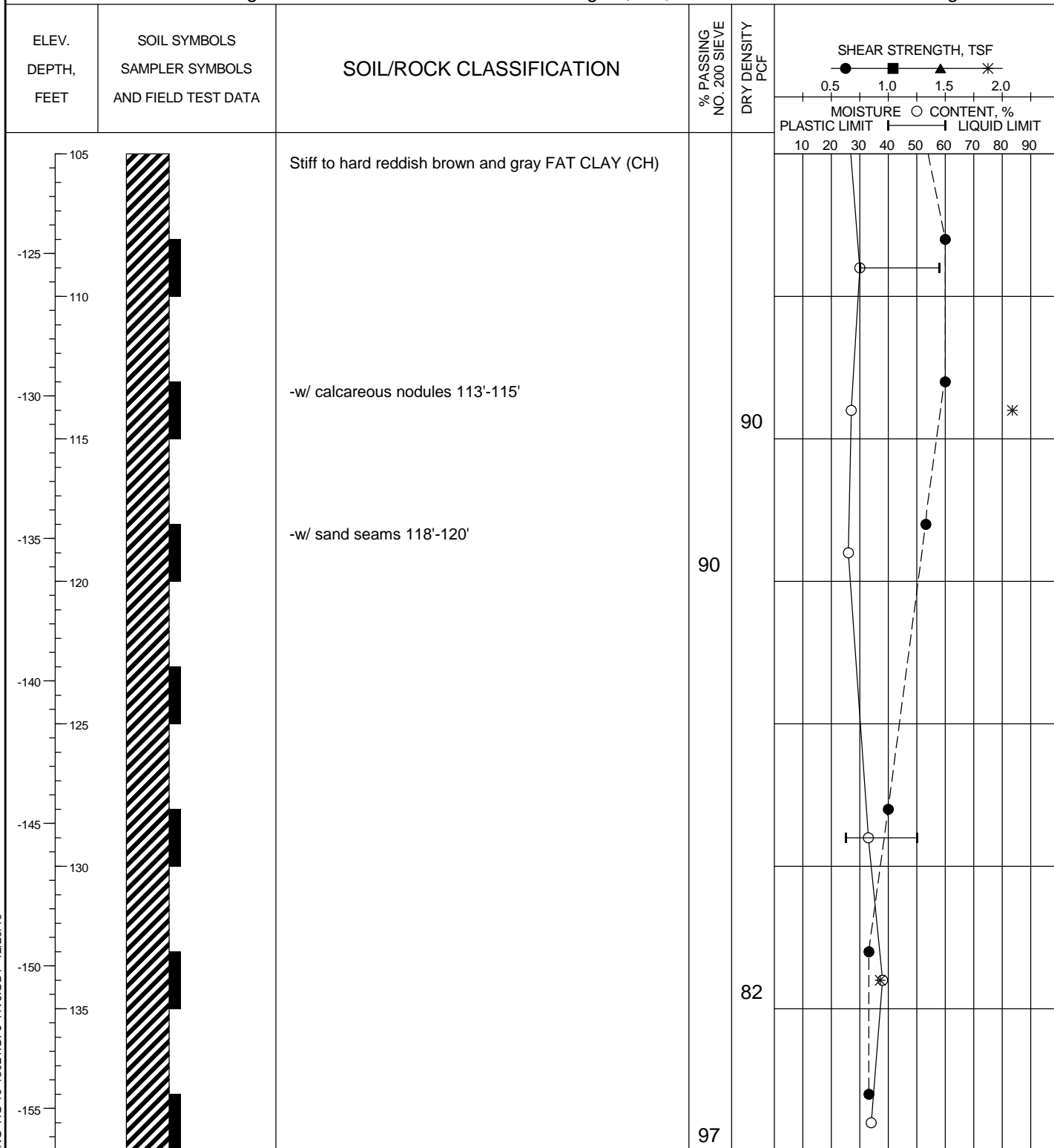
Project No.: HG1015021

Elevation MLT: -16.51 feet

Local Coord. Northing: -195.46

Local Coord. Easting: -42.49

LOG OF SOIL BORING HG-10-15021.GPJ HVJ.GDT 12/29/10



Shear Types:

● = Hand Penet.

■ = Torvane

▲ = Unconf. Comp.

\* = UU Triaxial

See Plate 2 for boring location.

PLATE A-6d



## SOIL SYMBOLS

### Soil Types



Clay



Silt



Sand



Gravel

### Modifiers



Clayey



Silty



Sandy



Cemented

### Construction Materials



Asphaltic  
Concrete



Stabilized  
Base



Fill or  
Debris



Portland  
Cement  
Concrete

## SAMPLER TYPES



Thin Walled  
Shelby Tube



No Recovery



Split Barrel



Core



Liner Tube



Jar Sample

## WATER LEVEL SYMBOLS



Groundwater level after drilling in  
open borehole or piezometer



Groundwater level determined during  
drilling operations

## SOIL GRAIN SIZE

### Classification

Clay  
Silt  
Sand  
Gravel  
Cobble  
Boulder

### Particle Size

< 0.002 mm  
0.002 - 0.075 mm  
0.075 - 4.75 mm  
4.75 - 75 mm  
75 - 200 mm  
> 200 mm

### Particle Size or Sieve No. (U.S. Standard)

< 0.002 mm  
0.002 mm - #200 sieve  
#200 sieve - #4 sieve  
#4 sieve - 3 in.  
3 in. - 8 in.  
> 8 in.

## DENSITY OF COHESIONLESS SOILS

Descriptive Term	Penetration Resistance "N" * Blows/Foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

## CONSISTENCY OF COHESIVE SOILS

Consistency	Undrained Shear Strength (tsf)	Penetration Resistance "N" * Blows/Foot
Very Soft	0 - 0.125	0 - 2
Soft	0.125 - 0.25	2 - 4
Firm	0.25 - 0.5	4 - 8
Stiff	0.5 - 1.0	8 - 16
Very Stiff	1.0 - 2.0	16 - 32
Hard	> 2.0	> 32

## PENETRATION RESISTANCE

3/6 Blows required to penetrate each of three consecutive 6-inch increments per ASTM D-1586 \*

50/4" If more than 50 blows are required, driving is discontinued and penetration at 50 blows is noted

0/18" Sampler penetrated full depth under weight of drill rods and hammer

\* The N value is taken as the blows required to penetrate the final 12 inches

## TERMS DESCRIBING SOIL STRUCTURE

<i>Slickensided</i>	Fracture planes appear polished or glossy, sometimes striated
<i>Fissured</i>	Breaks along definite planes of fracture with little resistance to fracturing
<i>Inclusion</i>	Small pockets of different soils, such as small lenses of sand scattered through a mass of clay
<i>Parting</i>	Inclusion less than 1/4 inch thick extending through the sample
<i>Seam</i>	Inclusion 1/4 inch to 3 inches thick extending through the sample
<i>Layer</i>	Inclusion greater than 3 inches thick extending through the sample
<i>Laminated</i>	Soil sample composed of alternating partings of different soil type
<i>Stratified</i>	Soil sample composed of alternating seams or layers of different soil type

<i>Intermixed</i>	Soil sample composed of pockets of different soil type and laminated or stratified structure is not evident
<i>Calcareous</i>	Having appreciable quantities of calcium carbonate
<i>Ferrous</i>	Having appreciable quantities of iron
<i>Nodule</i>	A small mass of irregular shape



6120 S. Dairy Ashford Road  
Houston, Texas 77072-1010  
281.933.7388 Ph  
281.933.7293 Fax

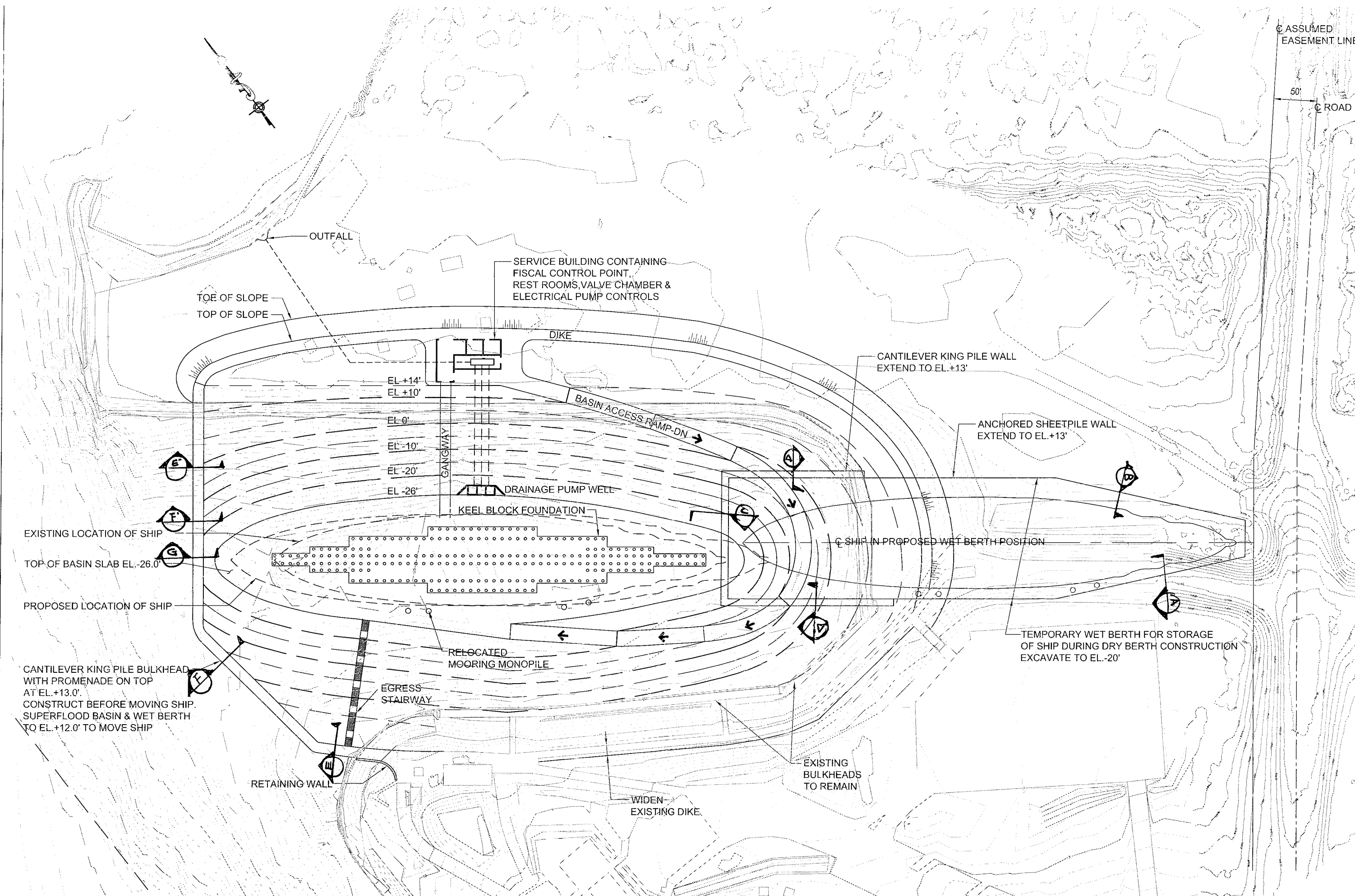
## KEY TO TERMS AND SYMBOLS USED ON BORING LOGS

PROJECT NO.:  
HG1015021

DRAWING NO.:  
PLATE A-7

**APPENDIX B**  
**ALTERNATIVE 1.2.1**





50'  
C. ASSUMED  
EASEMENT LINE  
C. ROAD

OUTFALL

TOE OF SLOPE  
TOP OF SLOPE

SERVICE BUILDING CONTAINING  
FISCAL CONTROL POINT,  
REST ROOMS, VALVE CHAMBER &  
ELECTRICAL PUMP CONTROLS

DIKE

CANTILEVER KING PILE WALL  
EXTEND TO EL.+13'

ANCHORED SHEETPILE WALL  
EXTEND TO EL.+13'

EL.+14'  
EL.+10'  
EL. 0'  
EL.-10'  
EL.-20'  
EL.-26'

BASIN ACCESS RAMP-DN

DRAINAGE PUMP WELL

KEEL BLOCK FOUNDATION

C. SHIP IN PROPOSED WET BERTH POSITION

EXISTING LOCATION OF SHIP

TOP OF BASIN SLAB EL.-26.0'

PROPOSED LOCATION OF SHIP

TEMPORARY WET BERTH FOR STORAGE  
OF SHIP DURING DRY BERTH CONSTRUCTION  
EXCAVATE TO EL.-20'

CANTILEVER KING PILE BULKHEAD  
WITH PROMENADE ON TOP  
AT EL.+13.0'.  
CONSTRUCT BEFORE MOVING SHIP.  
SUPERFLOOD BASIN & WET BERTH  
TO EL.+12.0' TO MOVE SHIP

RELOCATED  
MOORING MONOPILE

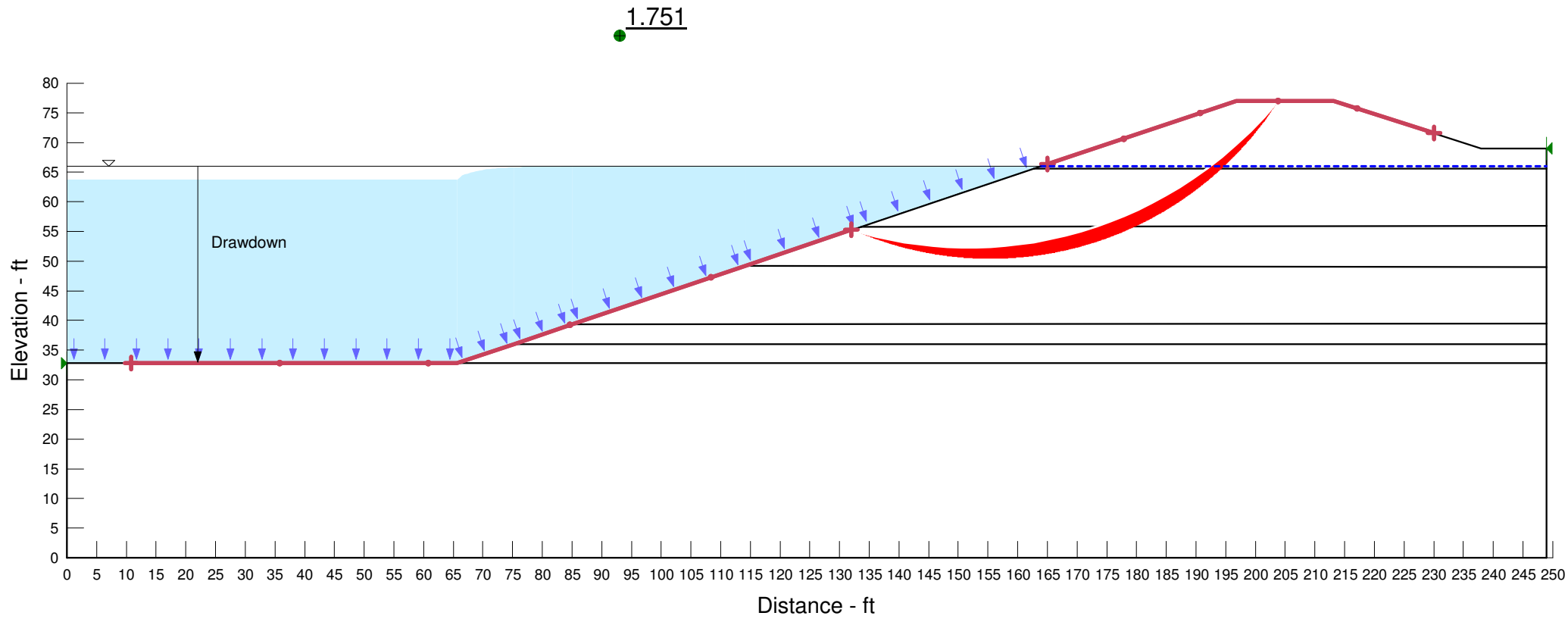
EGRESS  
STAIRWAY

RETAINING WALL

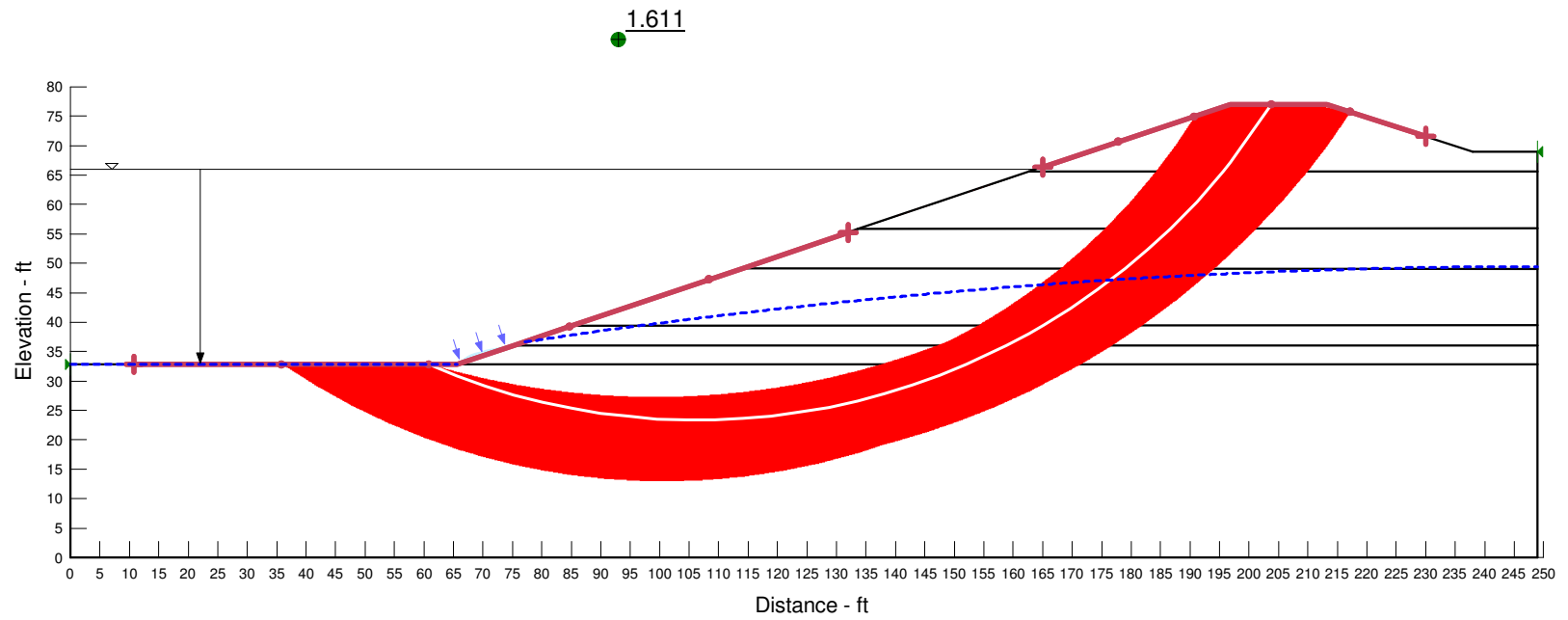
EXISTING  
BULKHEADS  
TO REMAIN

WIDEN  
EXISTING DIKE

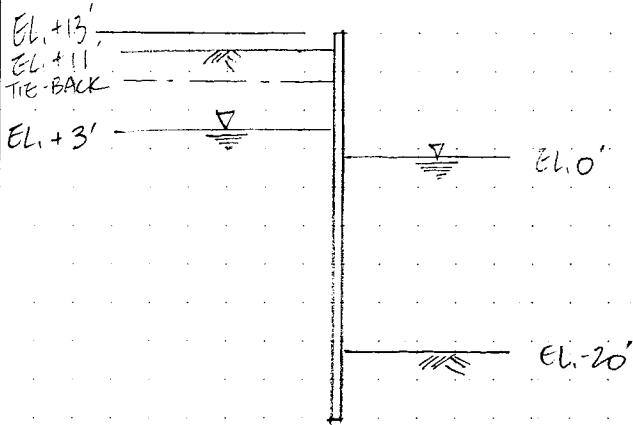
# Alternative 1.2.1 - Short Term Slope Stability



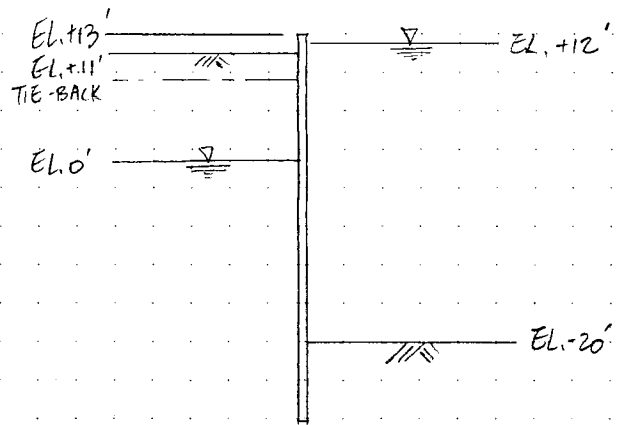
# Alternative 1.2.1 - Long Term Slope Stability



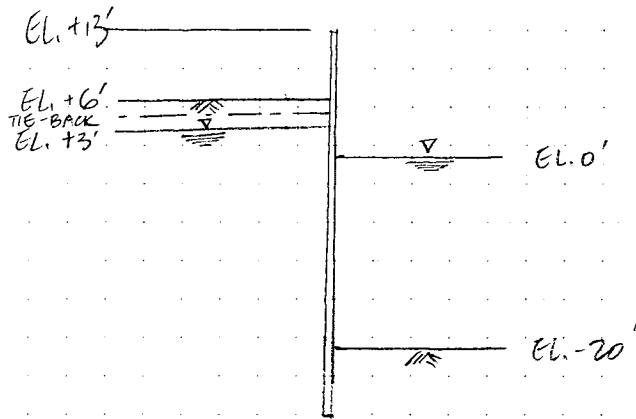
JOB TITLE USS Texas battleship (W1.2.1)  
 JOB NO. 60188085 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR IK DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE 1:20 SHEET NO. 1 OF \_\_\_\_\_



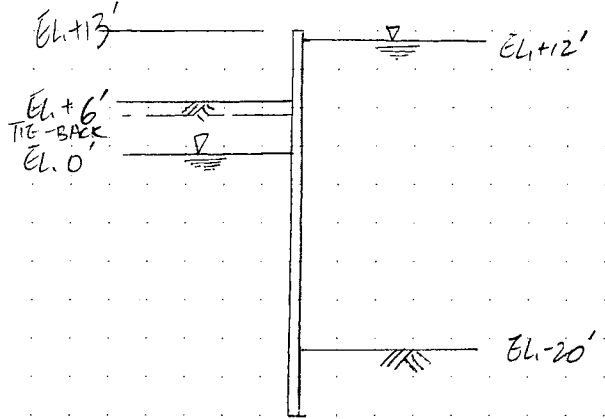
**(A)** Temp. Wet Berth Before Bringing in the Ship



**(A)** Temp. Wet Berth After Bringing in the Ship

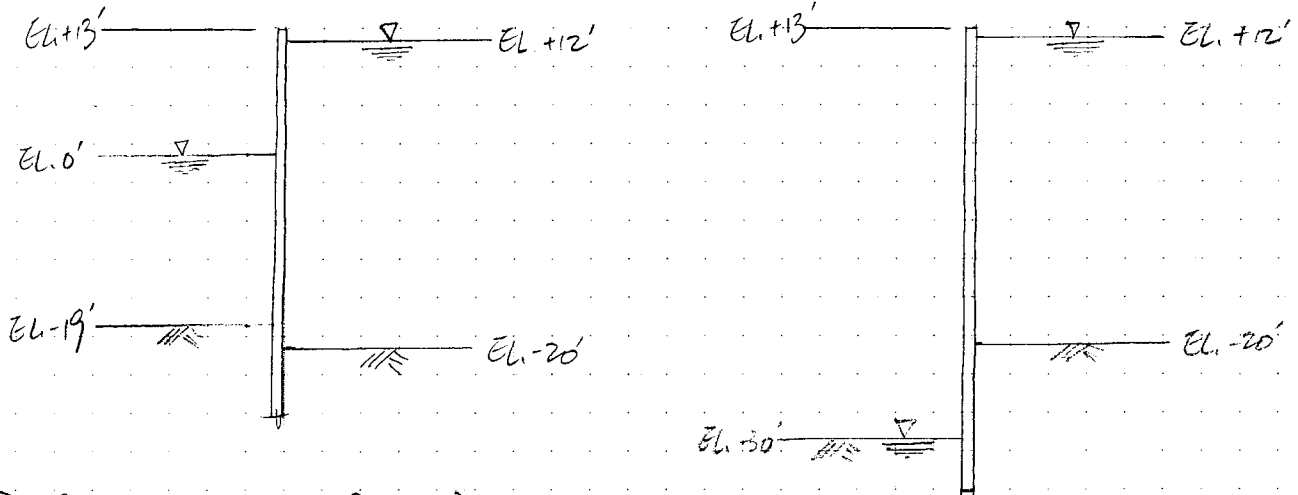


**(B)** Temp. Wet Berth Before Bringing in the Ship



**(B)** Temp. Wet Berth After Bringing in the Ship

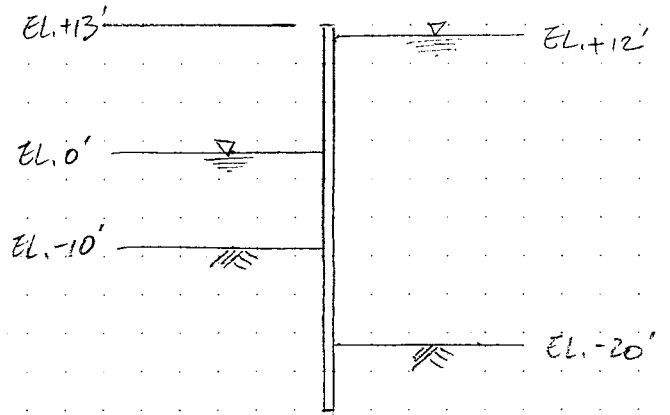
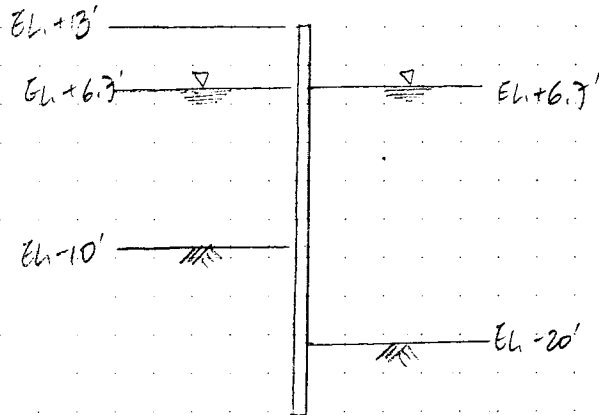
JOB TITLE USS Texas Battleship (W.12.1)  
 JOB NO. 60188085 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR IK DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE 1:20 SHEET NO. 2 OF \_\_\_\_\_



① Cantilever King Pile Wall  
 in Wet Berth After Bracing  
 in the Ship  
 (not governing)

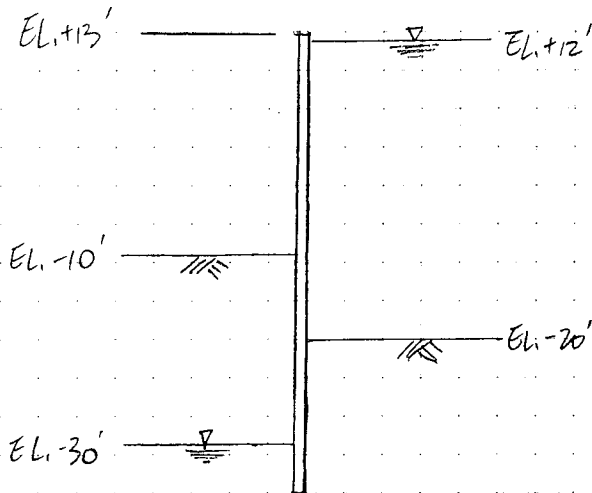
② Cantilever King Pile Wall in  
 Wet Berth After Bracing  
 in the Ship & Dredging in  
 the main Basin

JOB TITLE USS Texas Battleship (W1.2.1)  
 JOB NO. 60188085 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR IK DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE 1:20 SHEET NO. 3 OF \_\_\_\_\_



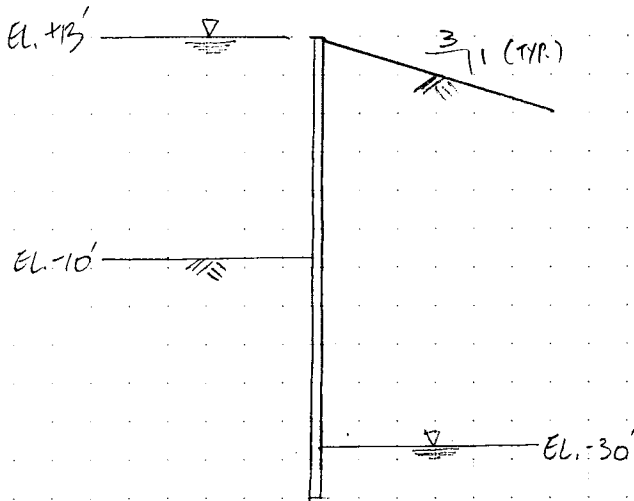
Ⓓ Temp. Cantilever King Pile Wall  
 Before Dredging in the Ship  
 (Not governing)

Ⓓ Temp. Cantilever King Pile Wall  
 After Dredging in the Ship  
 (Not governing)

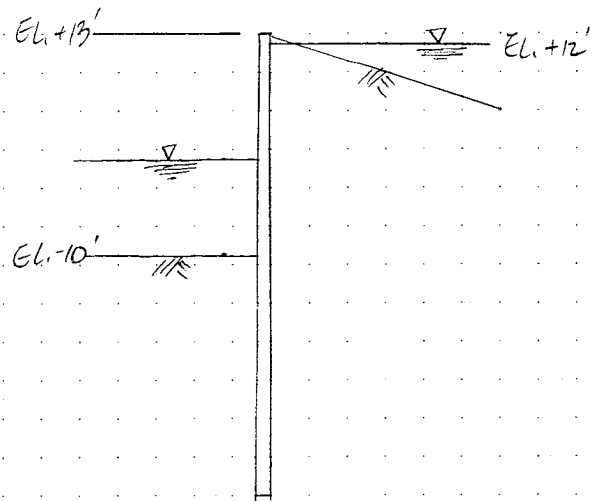


Ⓓ Temp. Cantilever King Pile Wall  
 After Dredging in the Ship  
 & After Dredging the main Basin

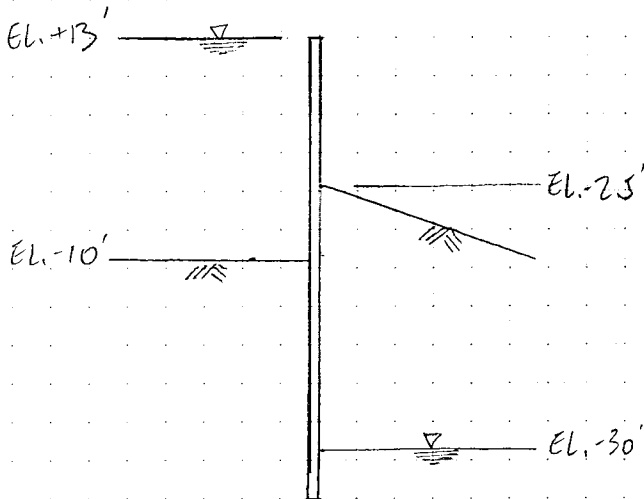
JOB TITLE USS Texas Battleship (W1.2.1)  
 JOB NO. 60182085 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR IK DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE 1:20 SHEET NO. 4 OF \_\_\_\_\_



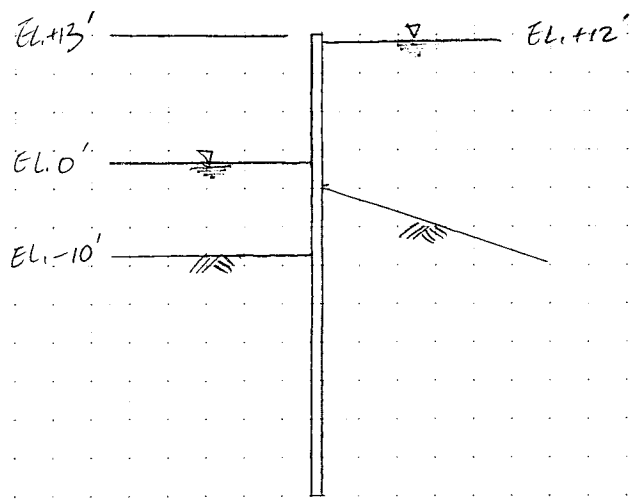
(E) Cantilever King Pile Wall  
Final Configuration



(E) Cantilever King Pile Wall  
While Bringing in the Ship

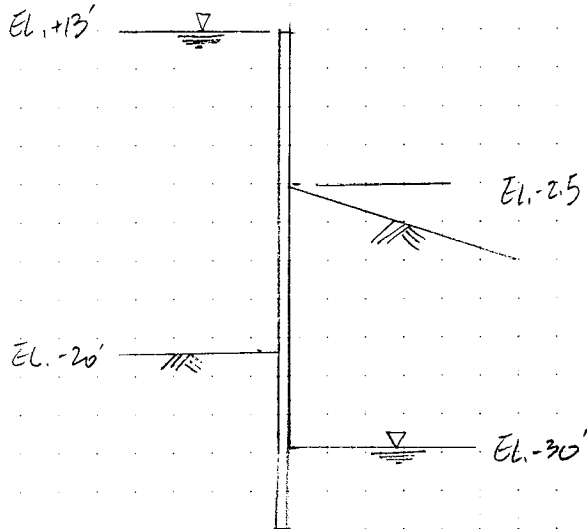


(E) Cantilever King Pile Wall  
Final Configuration

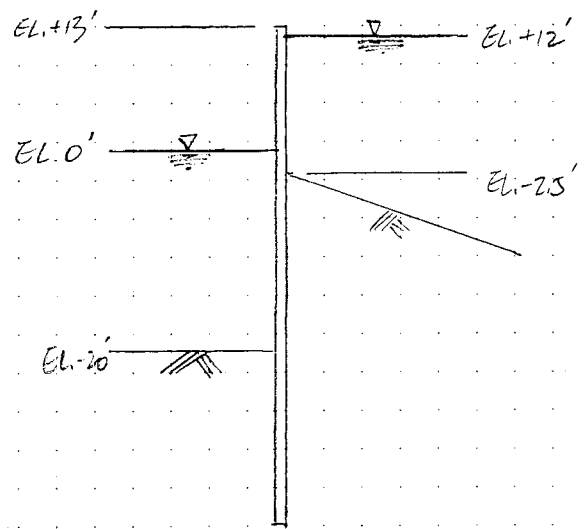


(E) Cantilever King Pile Wall  
While Bringing in the Ship

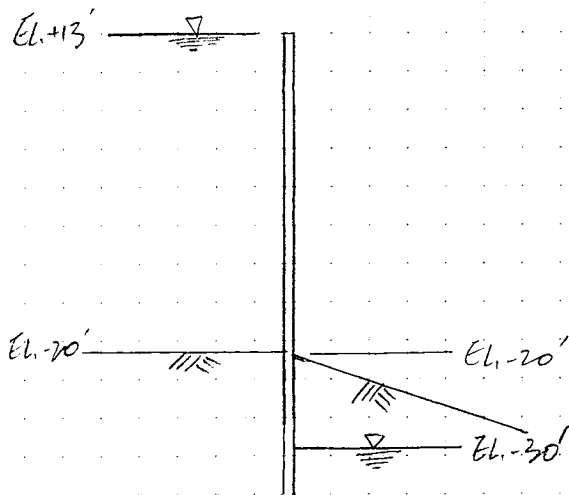
JOB TITLE USS Texas Battleship (W1.2.1)  
 JOB NO. 60128085 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR IK DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE 1:20 SHEET NO. 5 OF \_\_\_\_\_



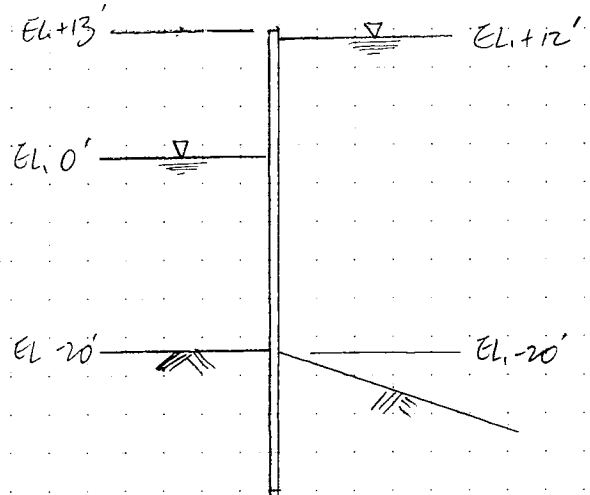
(F) Cantilever King Pile Wall  
Final Configuration



(F) Cantilever King Pile Wall  
While Bringing in the Ship



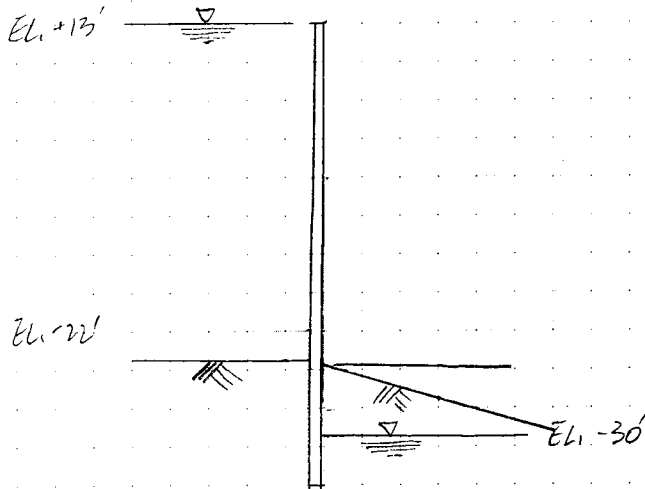
(F') Cantilever King Pile Wall  
Final Configuration



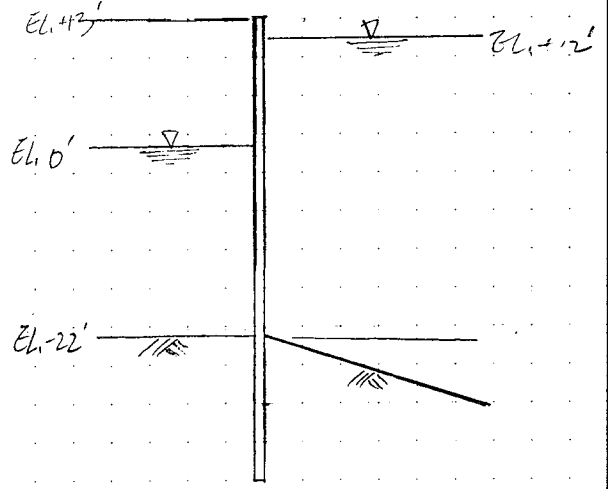
(F') Cantilever King Pile Wall  
While Bringing in the Ship  
 (Not governing)



JOB TITLE USS Texas Battle Ship (W1.2.1)  
 JOB NO. 60188085 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR IK DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE 1"=20' SHEET NO. 6 OF \_\_\_\_\_

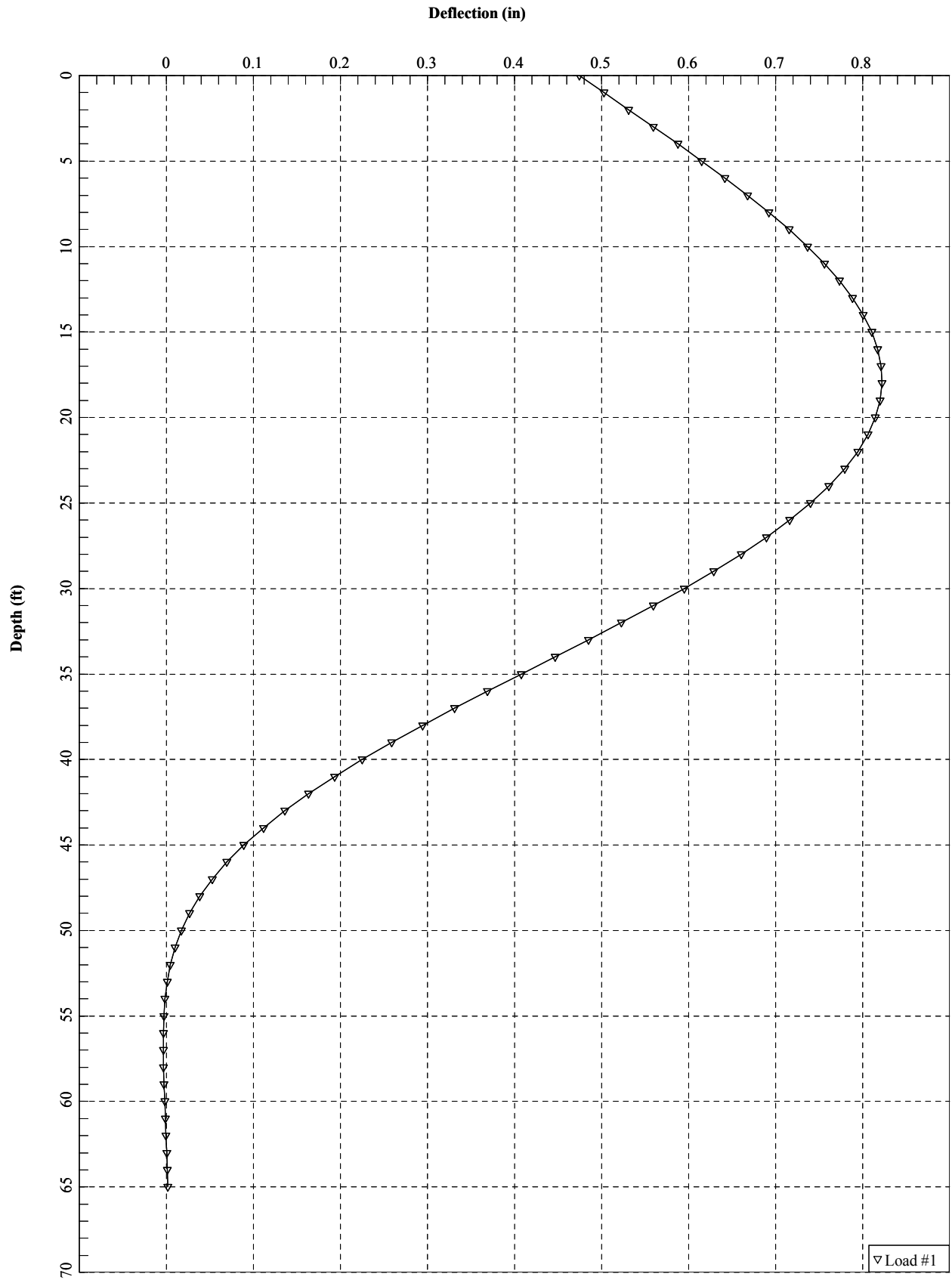


⑦ Cantilever King Pile Wall  
Final Configuration

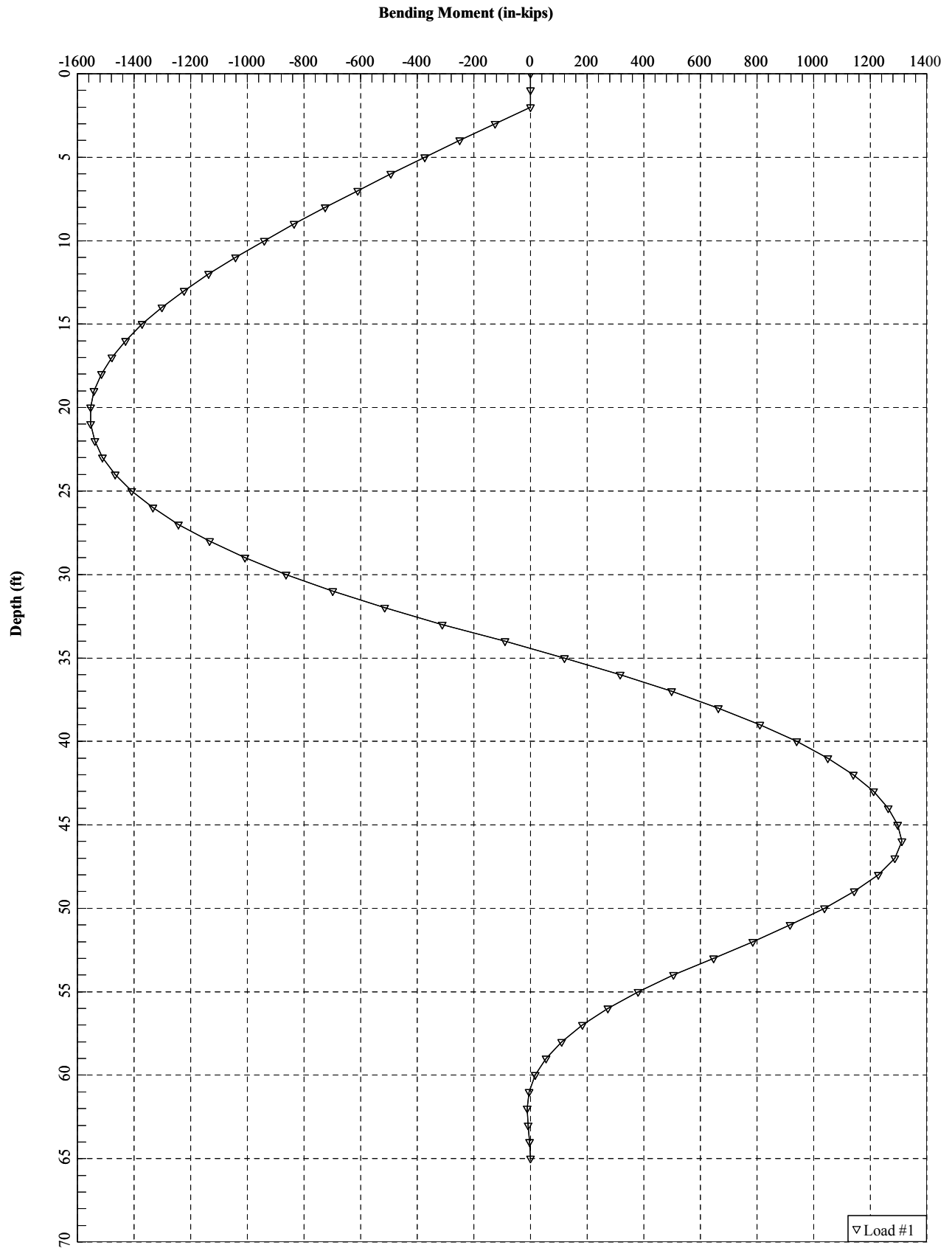


⑦ Cantilever King Pile Wall  
While Bringing in the Ship  
 (Not governing)

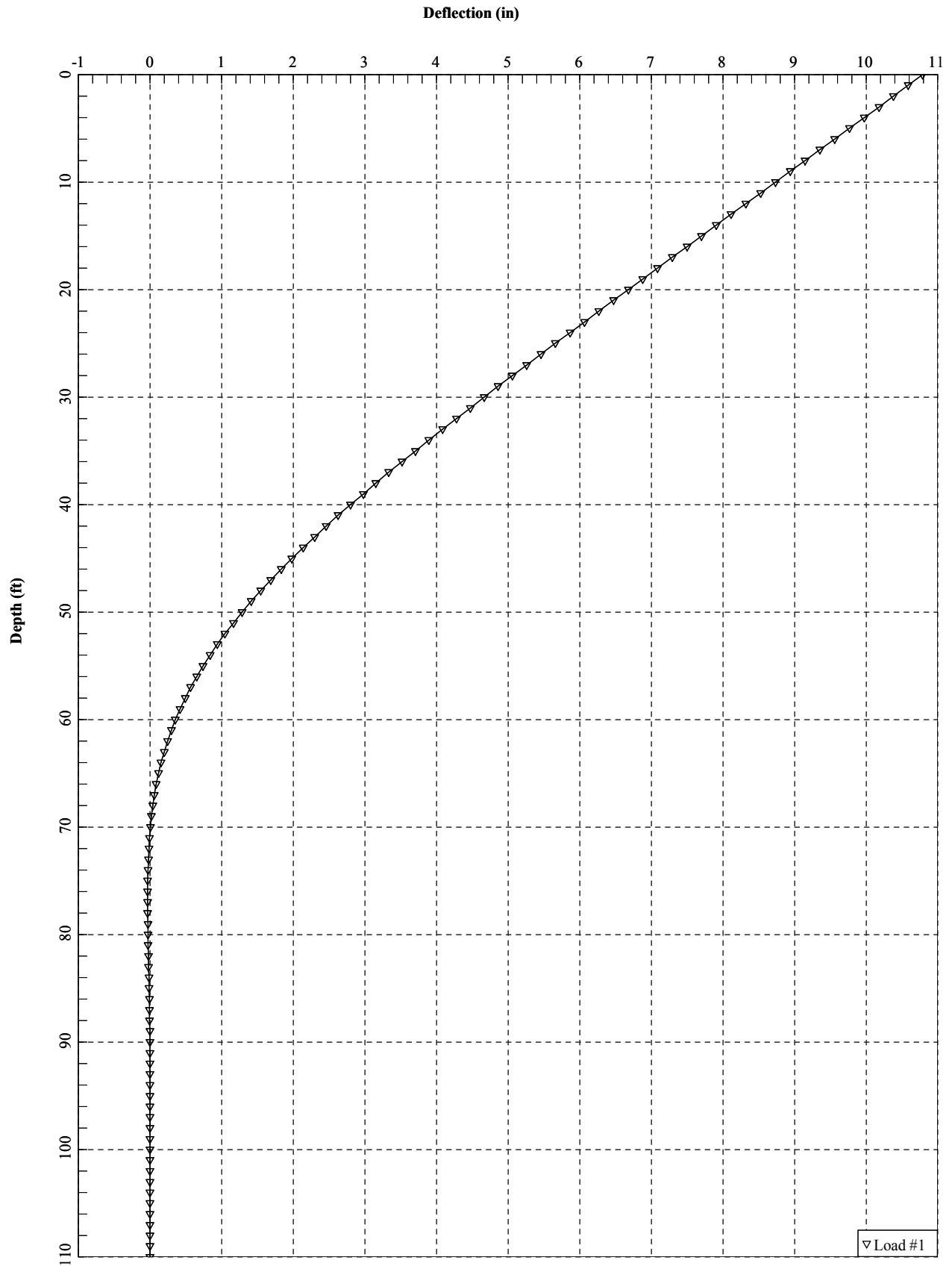
Battleship Texas, Alt. 1.2.1, Section A, Before Bringing In Ship



Battleship Texas, Alt. 1.2.1, Section A, Before Bringing In Ship

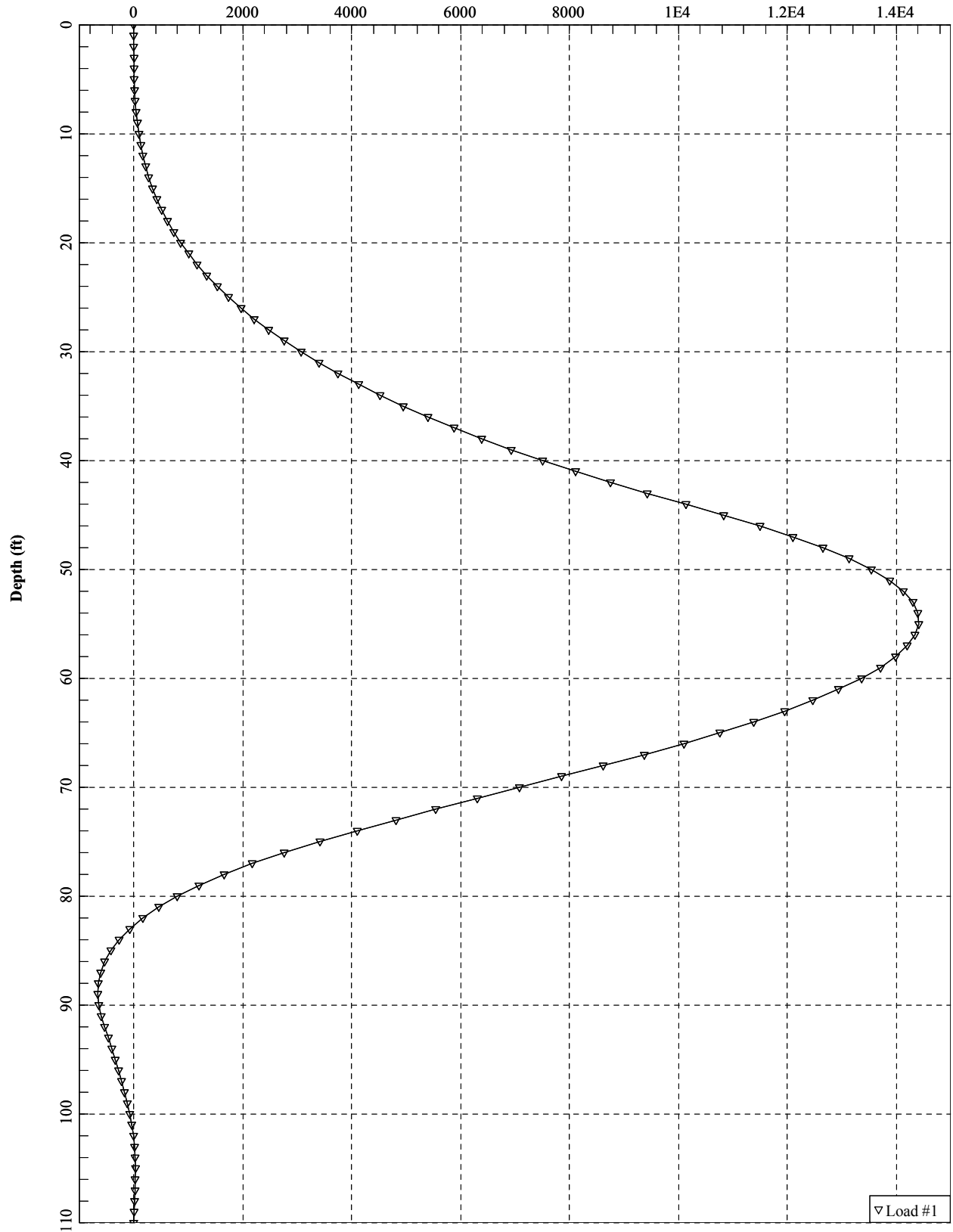


**Battleship Texas, Alt. 1.2.1, Section C, After Dredging Main Basin**

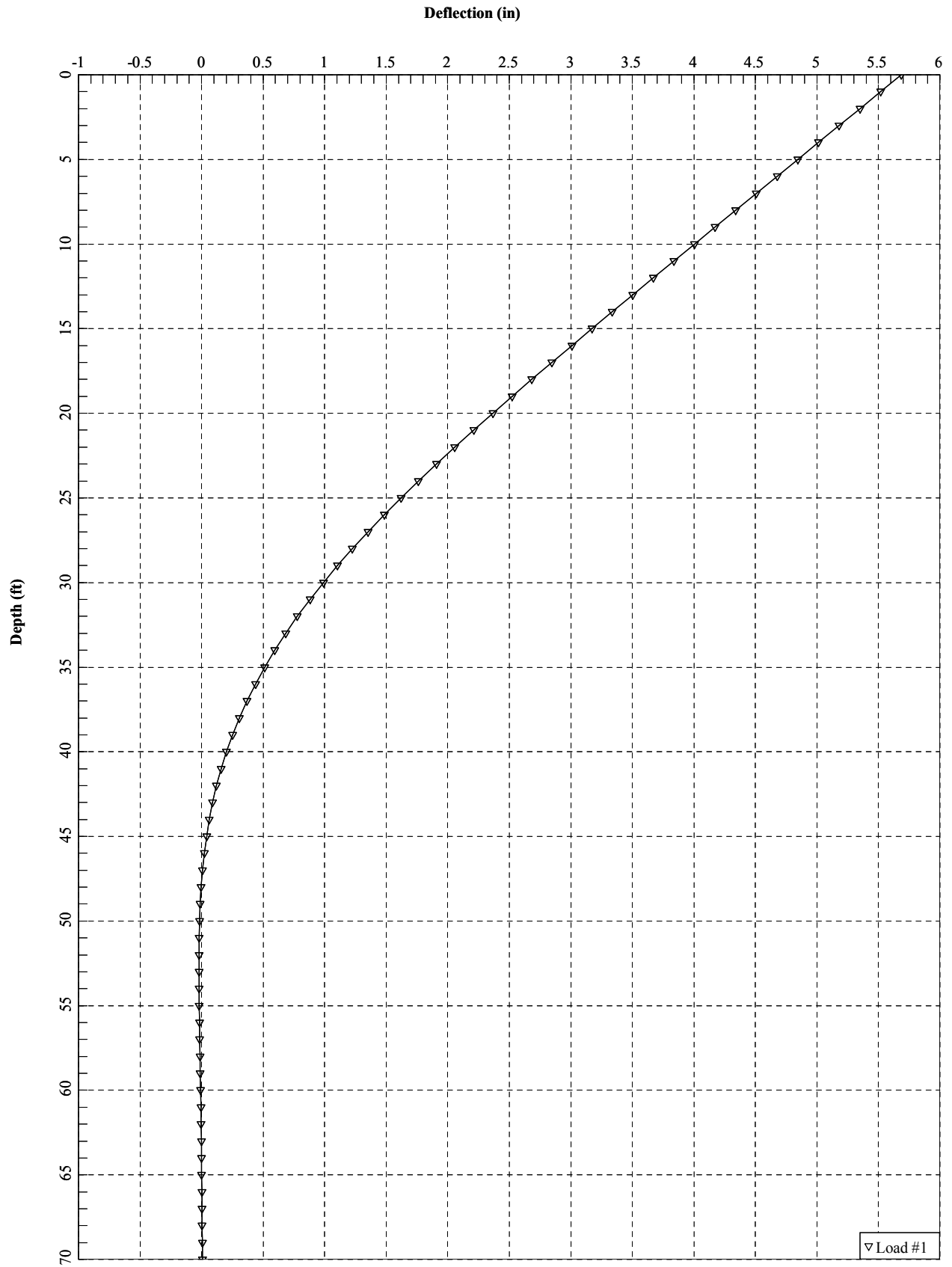


**Battleship Texas, Alt. 1.2.1, Section C, After Dredging Main Basin**

**Bending Moment (in-kips)**

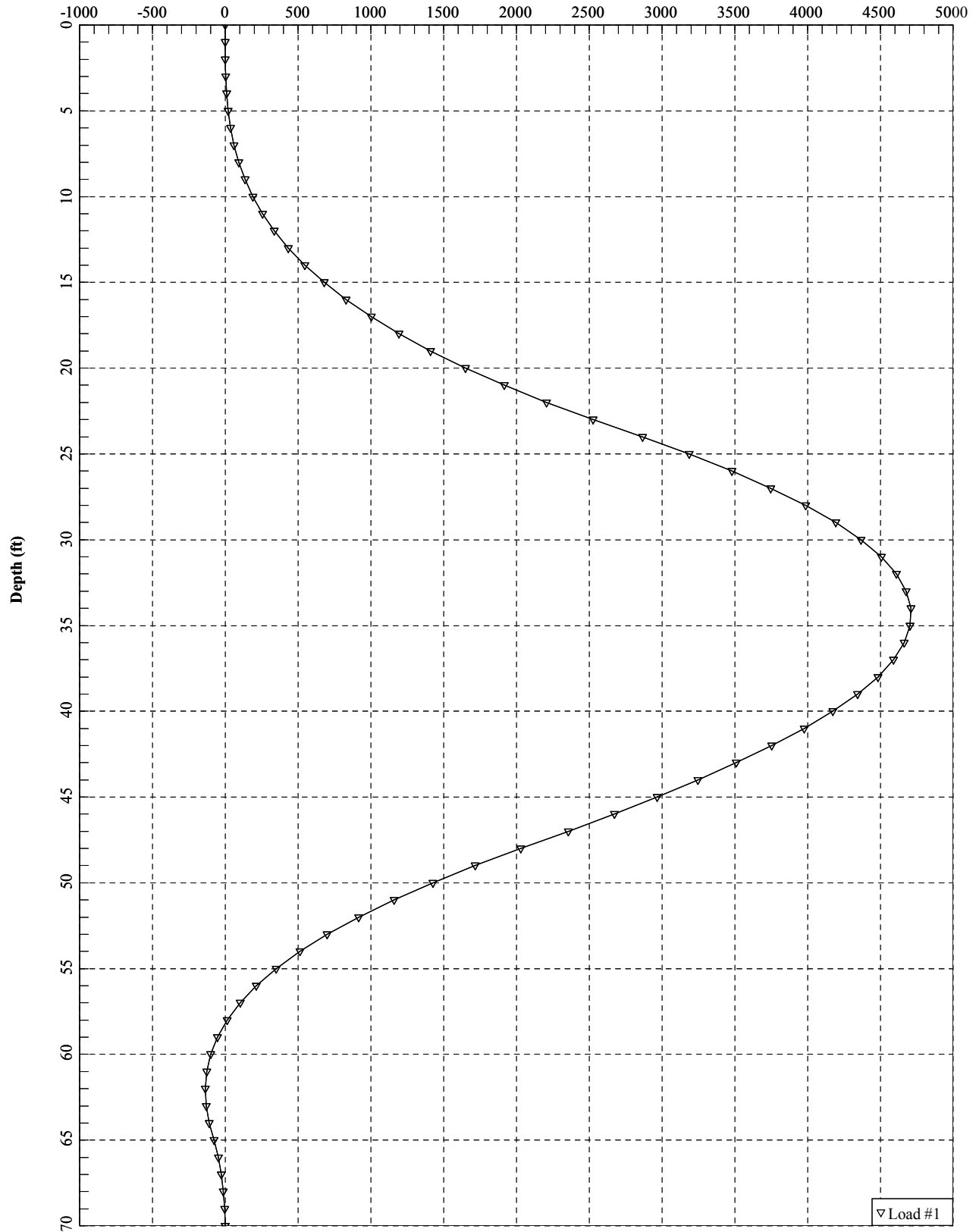


**Battleship Texas, Alt. 1.2.1, Section E, While Bringing In Ship**

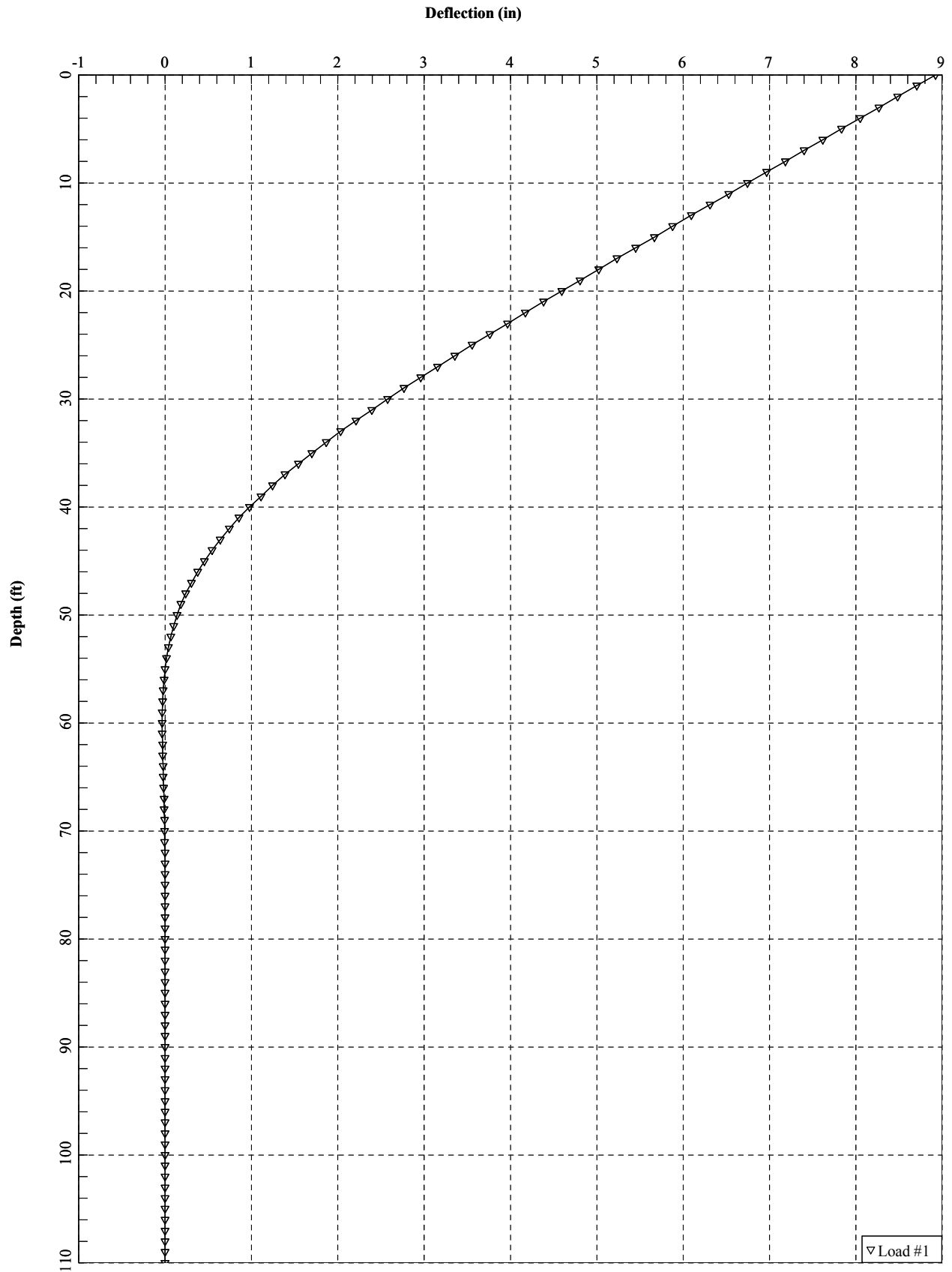


Battleship Texas, Alt. 1.2.1, Section E, While Bringing In Ship

Bending Moment (in-kips)



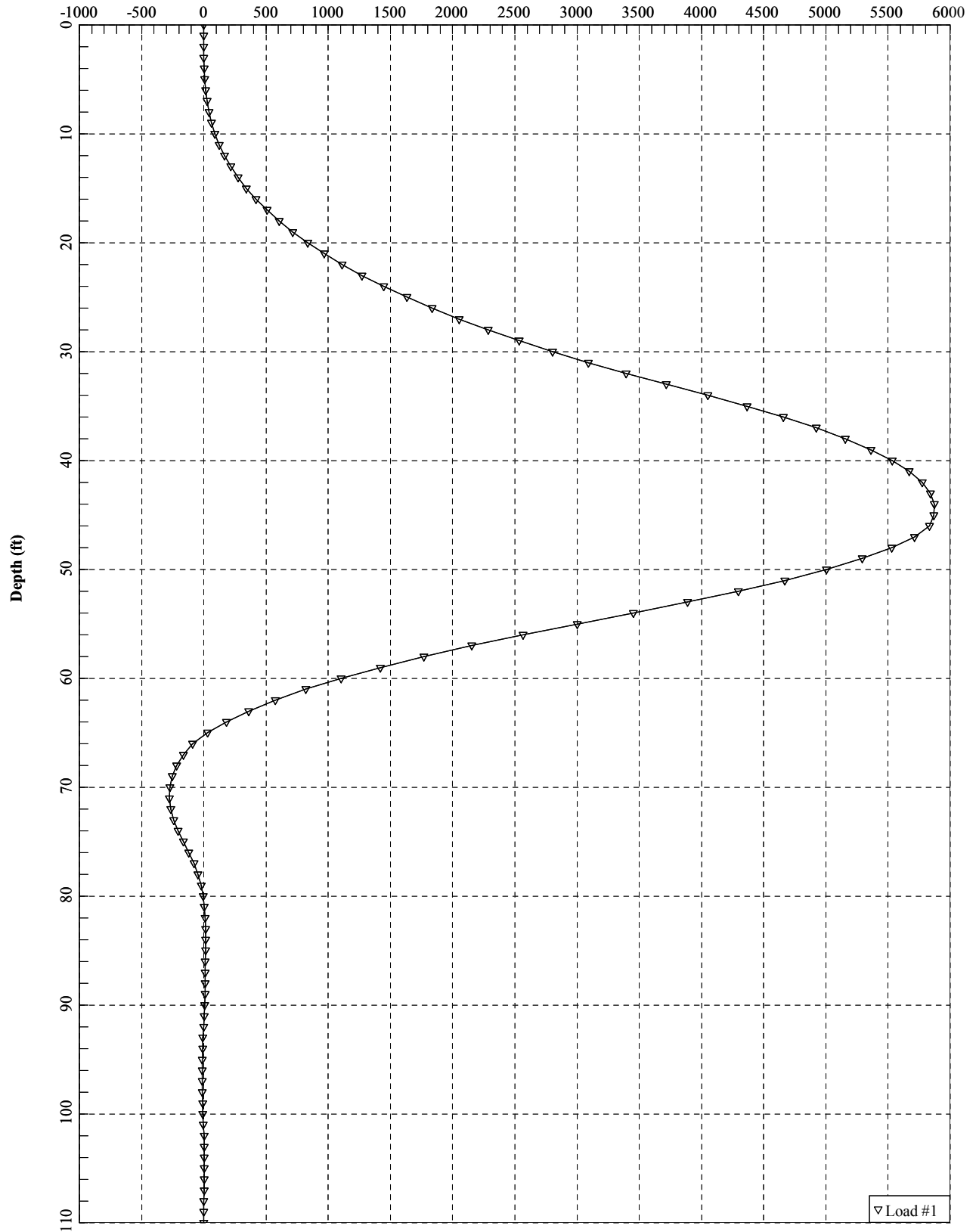
**Battleship Texas, Alt. 1.2.1, Section F, While Bringing In Ship**



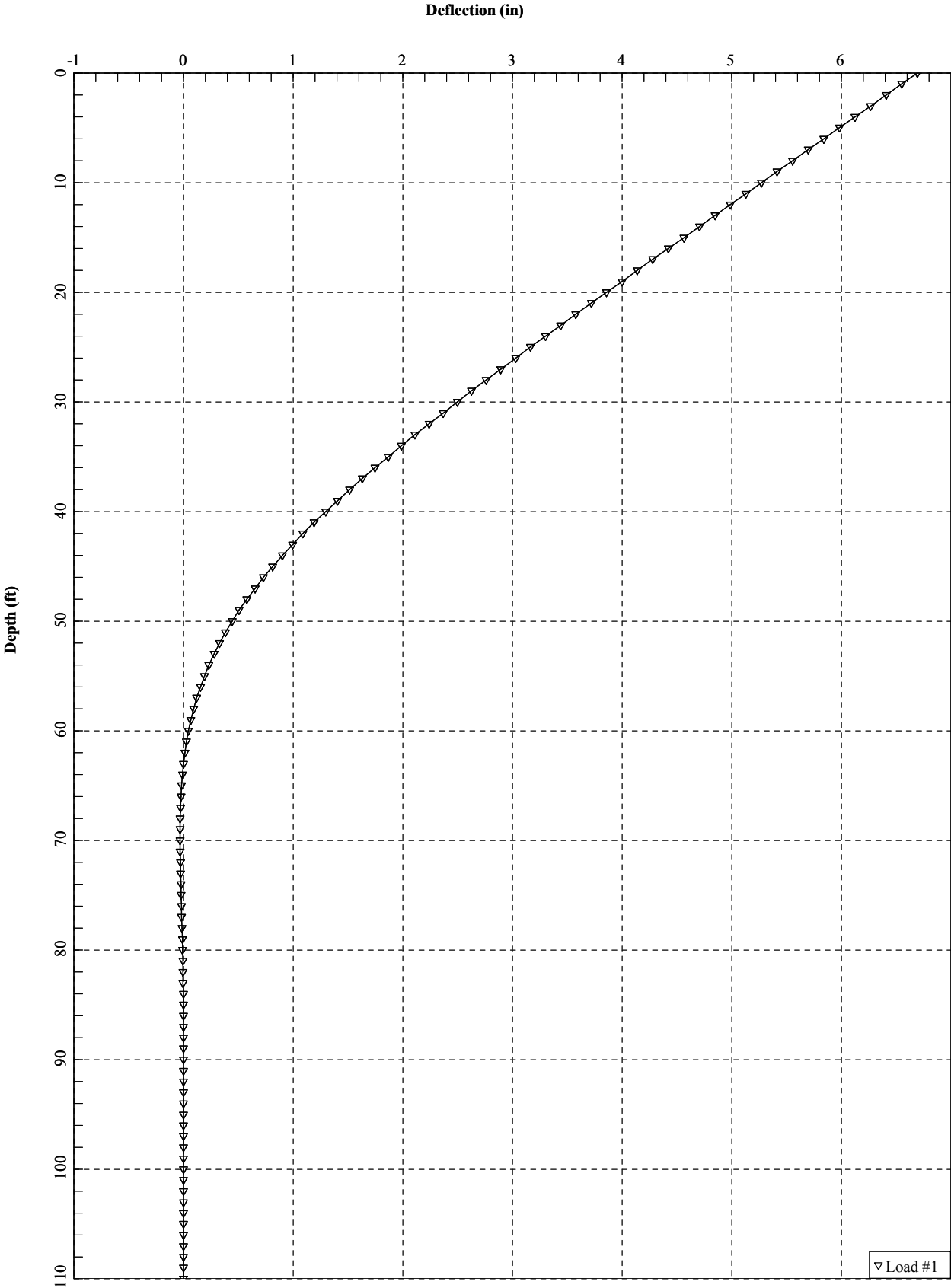


Battleship Texas, Alt. 1.2.1, Section F, While Bringing In Ship

Bending Moment (in-kips)

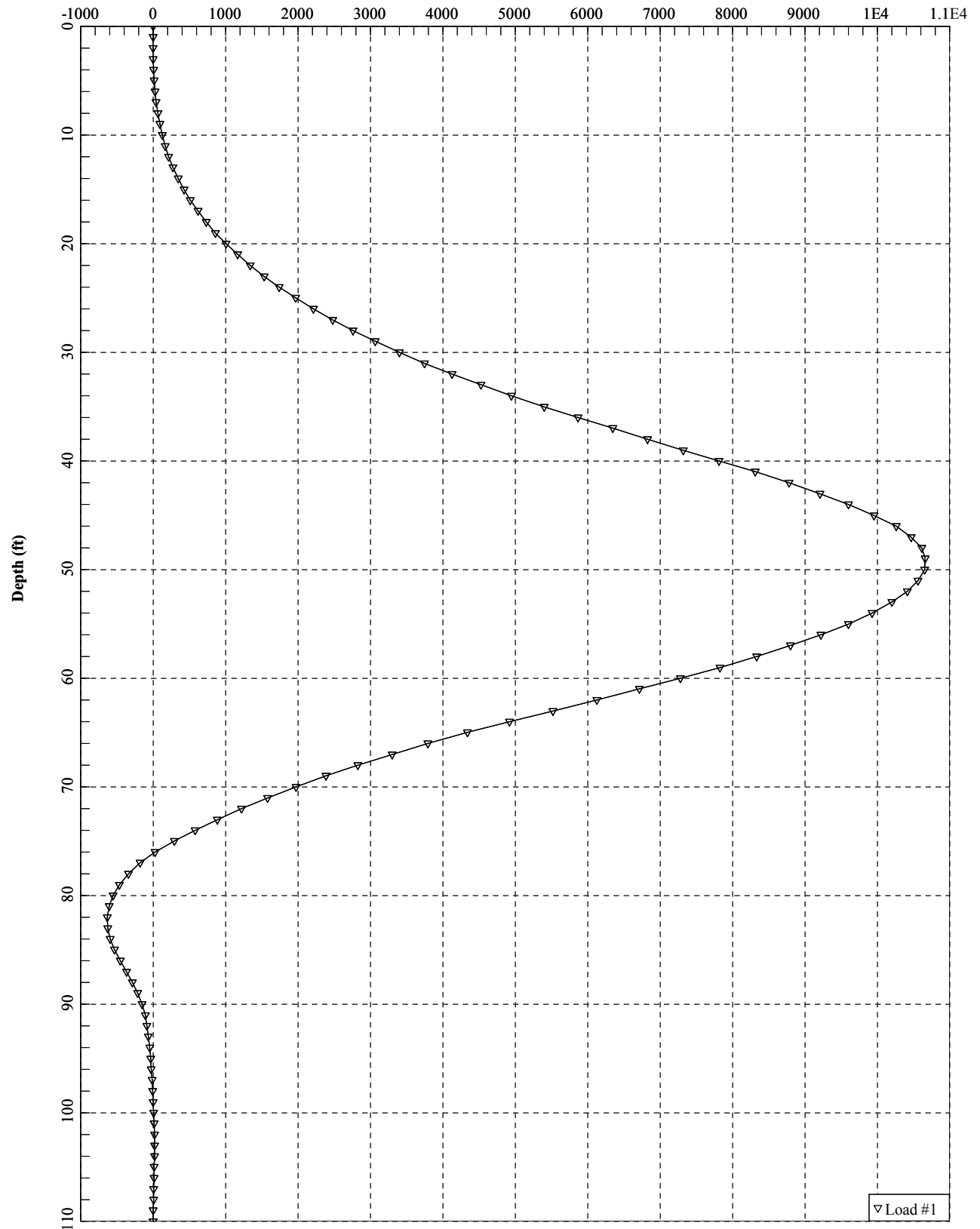


Battleship Texas, Alt. 1.2.1, Section G, Final Configuration

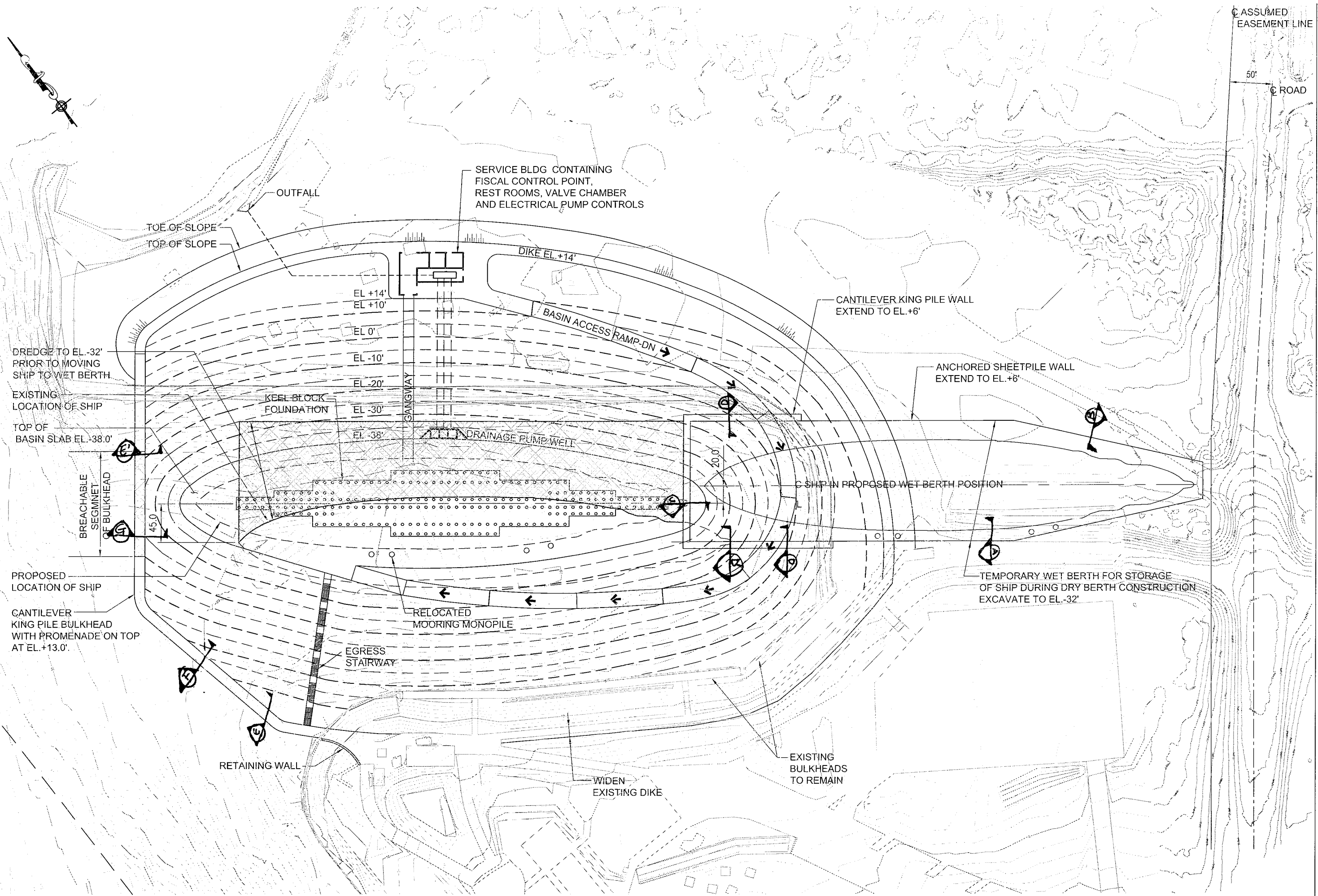


Battleship Texas, Alt. 1.2.1, Section G, Final Configuration

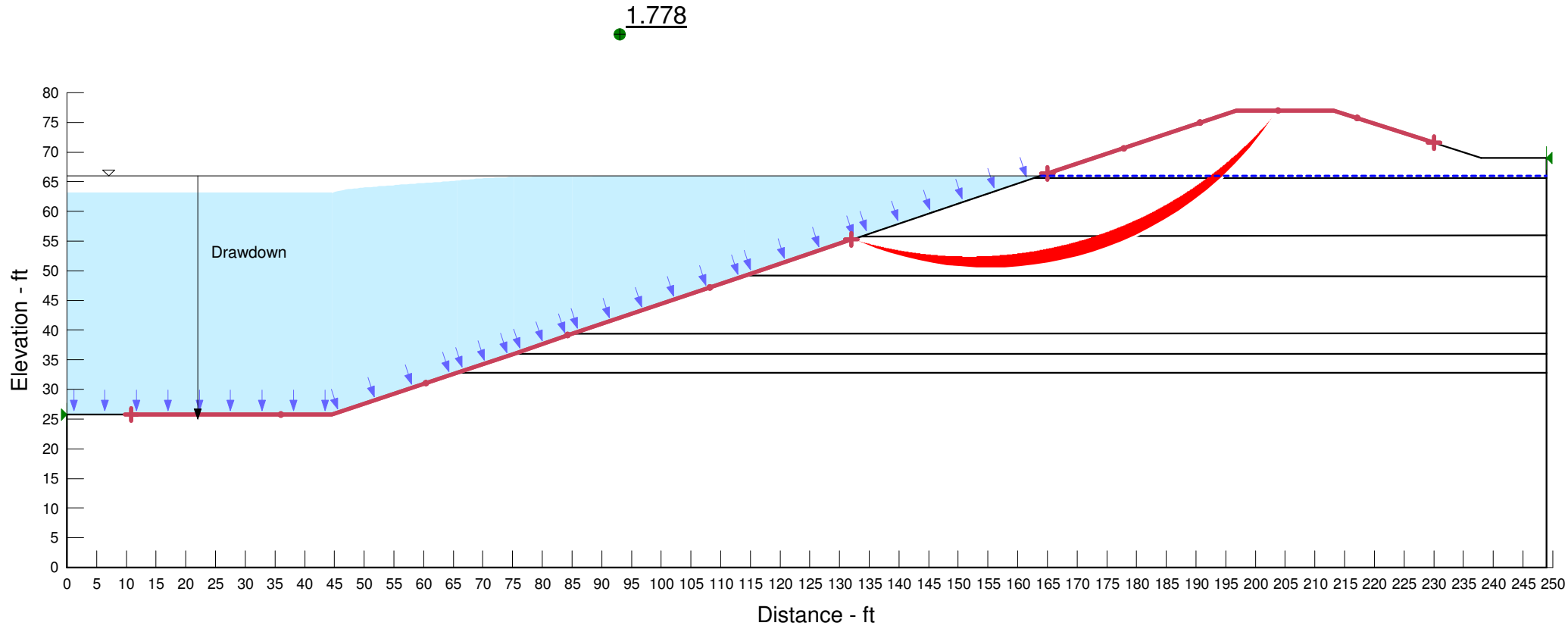
Bending Moment (in-kips)



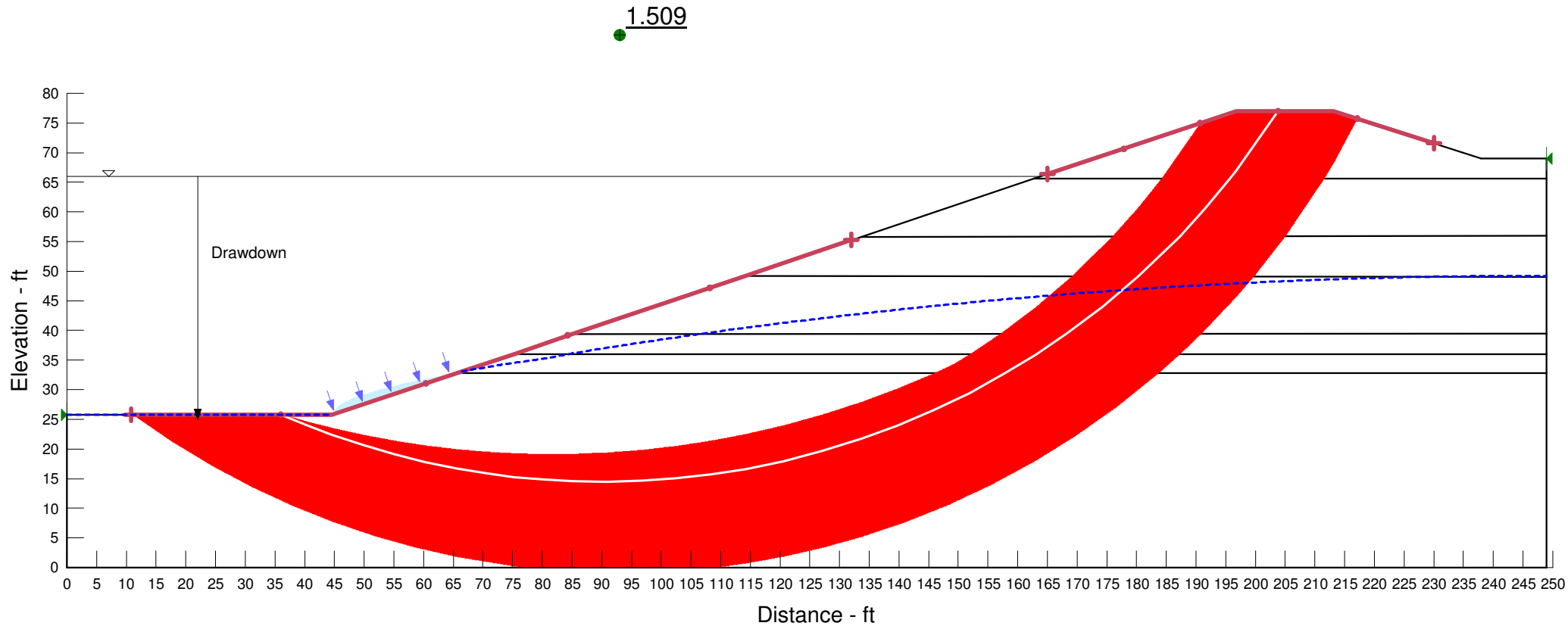
**APPENDIX C**  
**ALTERNATIVE 1.3**



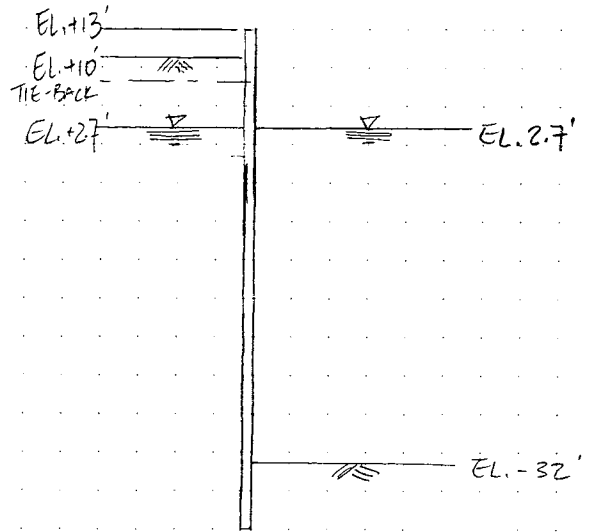
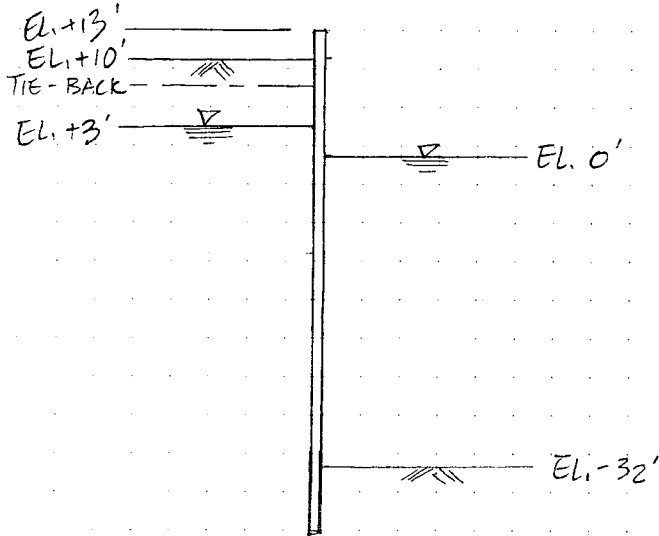
# Alternative 1.3 - Short Term Slope Stability



# Alternative 1.3 - Long Term Slope Stability

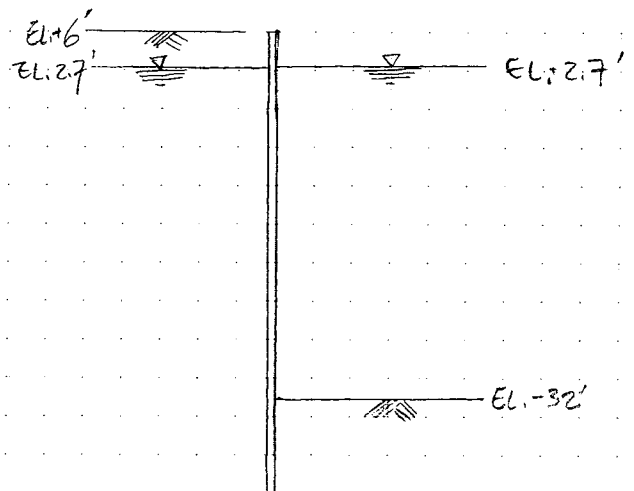
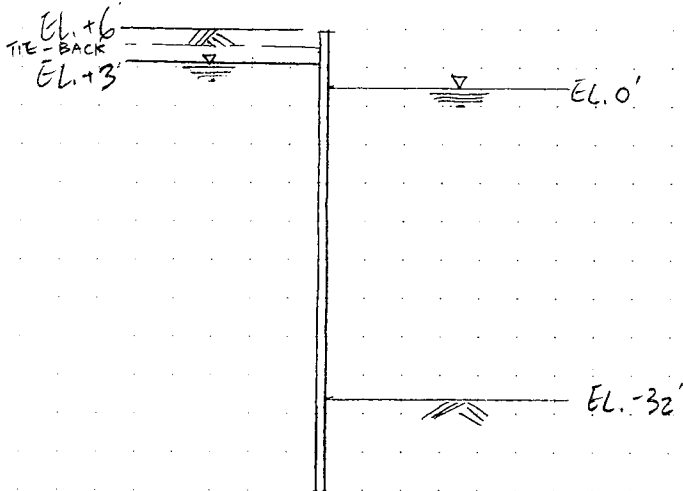


JOB TITLE USS Texas Battleship (W1.3)  
 JOB NO. 60188085 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR IK DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE \_\_\_\_\_ SHEET NO. 1 OF \_\_\_\_\_



A. Temp. Wet Berth Before  
Bringing in the Ship

A. Temp. Wet Berth After  
Bringing in the Ship  
(NOT governing)

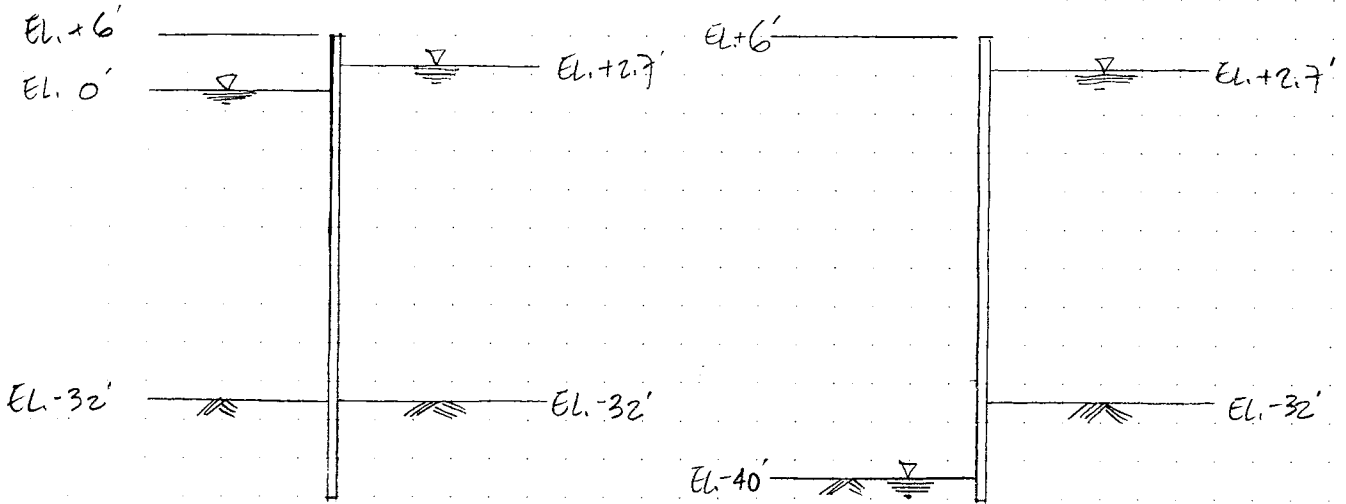


B. Temp. Wet Berth Before  
Bringing in the Ship

B. Temp. Wet Berth After  
Bringing in the Ship  
(NOT governing)



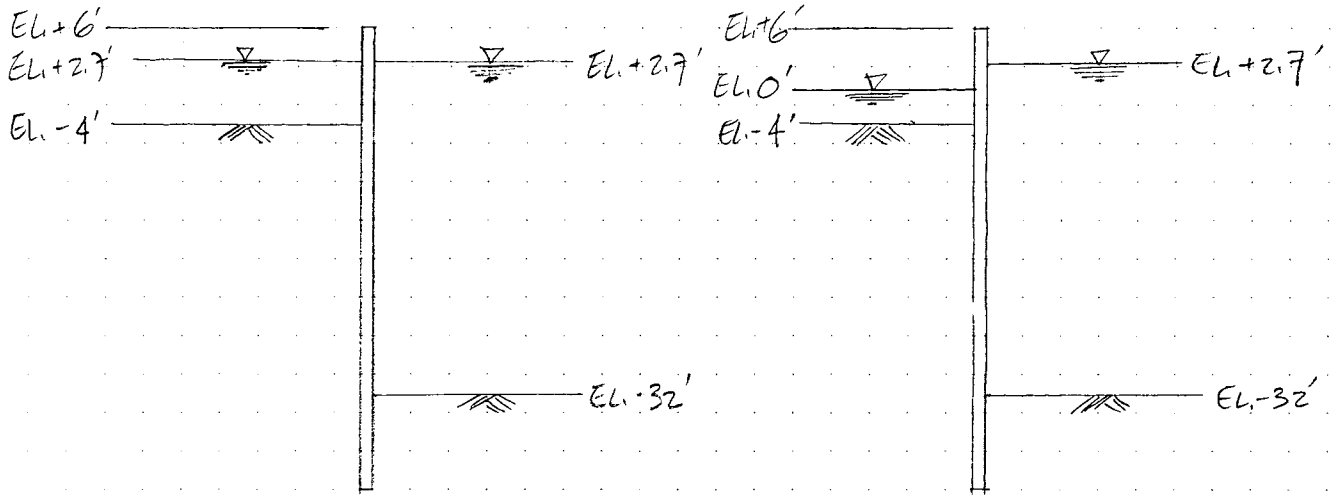
JOB TITLE USS Texas Battleship (W1.3)  
 JOB NO. 60188025 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR IK DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE \_\_\_\_\_ SHEET NO. 2 OF \_\_\_\_\_



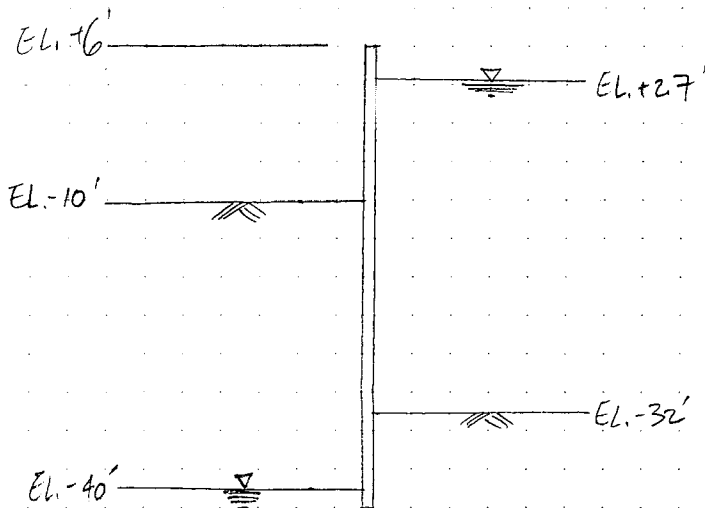
(C) Cantilever King Pile Wall in  
Wet Berth, After Bringing in the  
Ship *not necessary*

(C) Cantilever King Pile Wall in  
Wet Berth. After Bringing in the  
Ship & After Dredging the Main  
Basin

JOB TITLE USS Texas Battleship (W1.3)  
 JOB NO. 6018 E085 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR IK DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE \_\_\_\_\_ SHEET NO. 3 OF \_\_\_\_\_

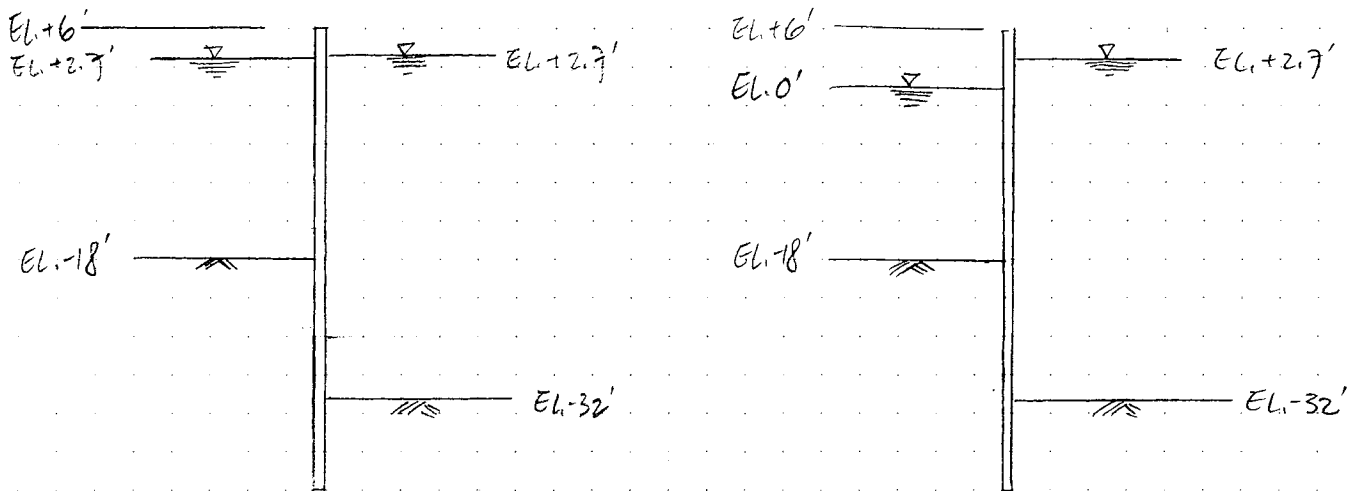


(D) Cantilever King Pile Wall in Wet Berth, Before Bringing in the Ship (D) Cantilever King Pile Wall in Wet Berth, After Bringing in the Ship



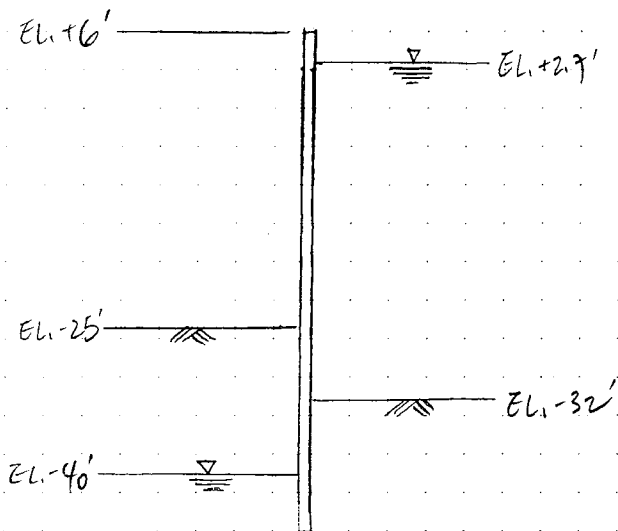
(D) Cantilever King Pile Wall in Wet Berth, After Bringing in the Ship & After Dredging the Main Basin

JOB TITLE USS Texas Battleship (W1.3)  
 JOB NO. 60188085 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR IK DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE \_\_\_\_\_ SHEET NO. 4 OF \_\_\_\_\_



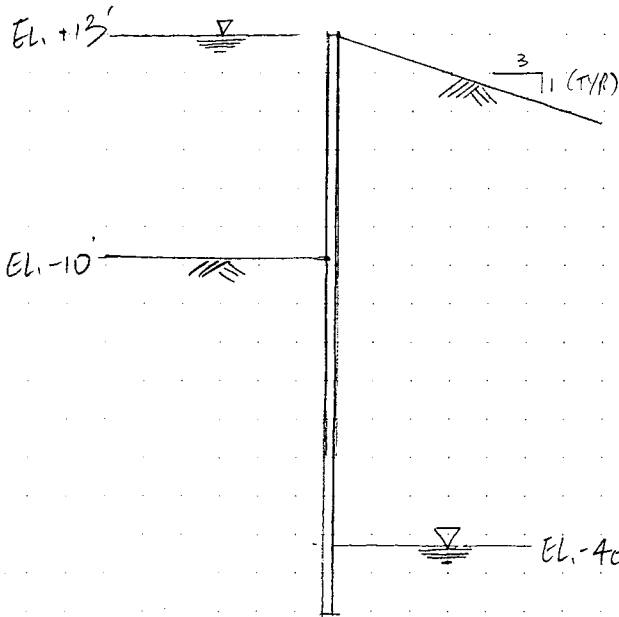
D' Cantilever King Pile Wall in Wet Berth. Before Bringing in the Ship

D' Cantilever King Pile Wall in Wet Berth. After Bringing in the Ship

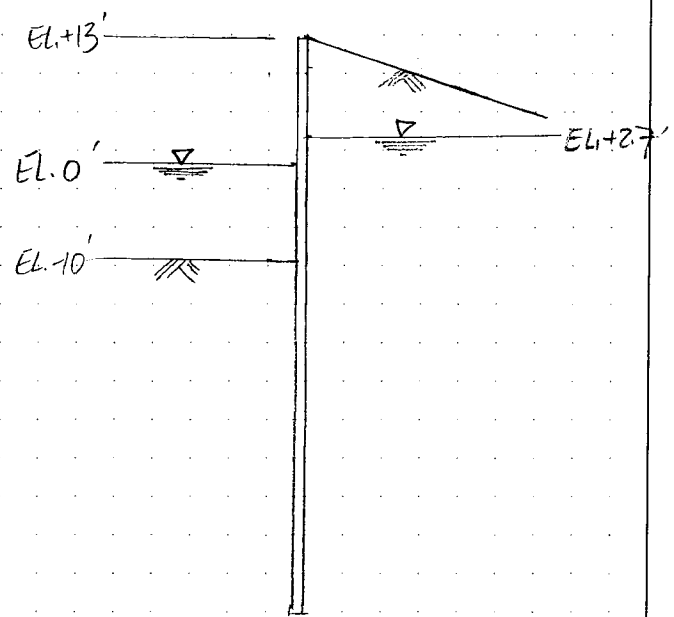


D' Cantilever King Pile Wall in Wet Berth. After Bringing in the Ship & After Dredging the Main Basin

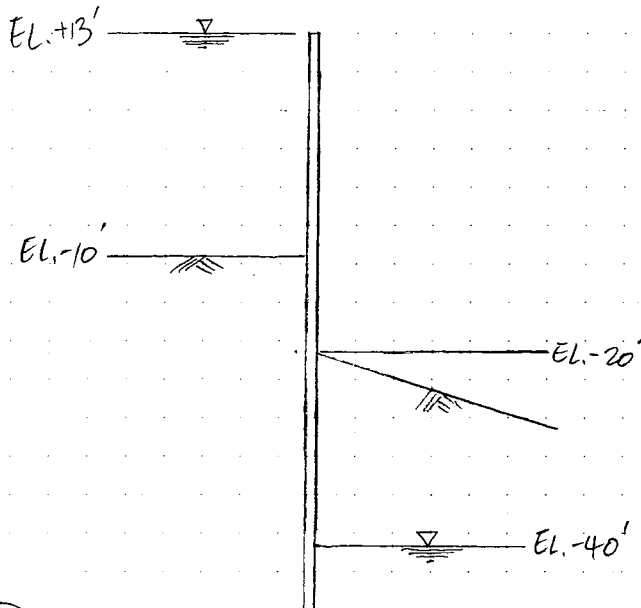
JOB TITLE USS Texas Battleship (W1.3)  
 JOB NO. 60188085 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR IK DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE \_\_\_\_\_ SHEET NO. 5 OF \_\_\_\_\_



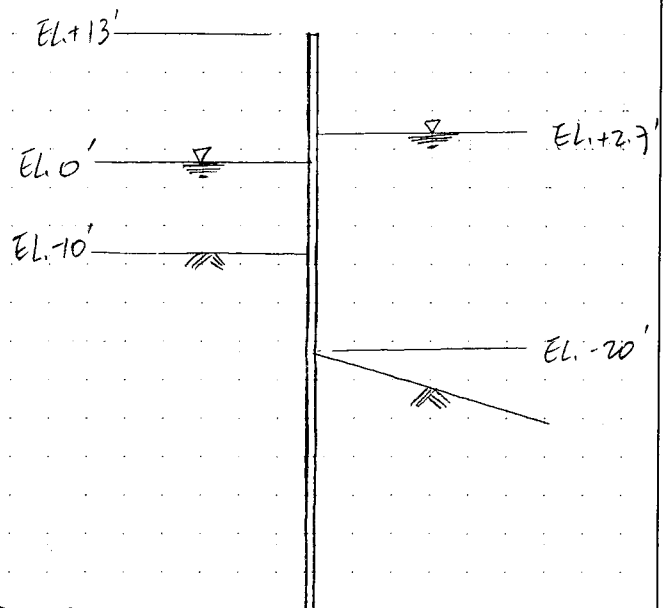
E. Cantilever King Pile Wall  
Final Configuration



E. Cantilever King Pile Wall  
While Bringing in the Ship

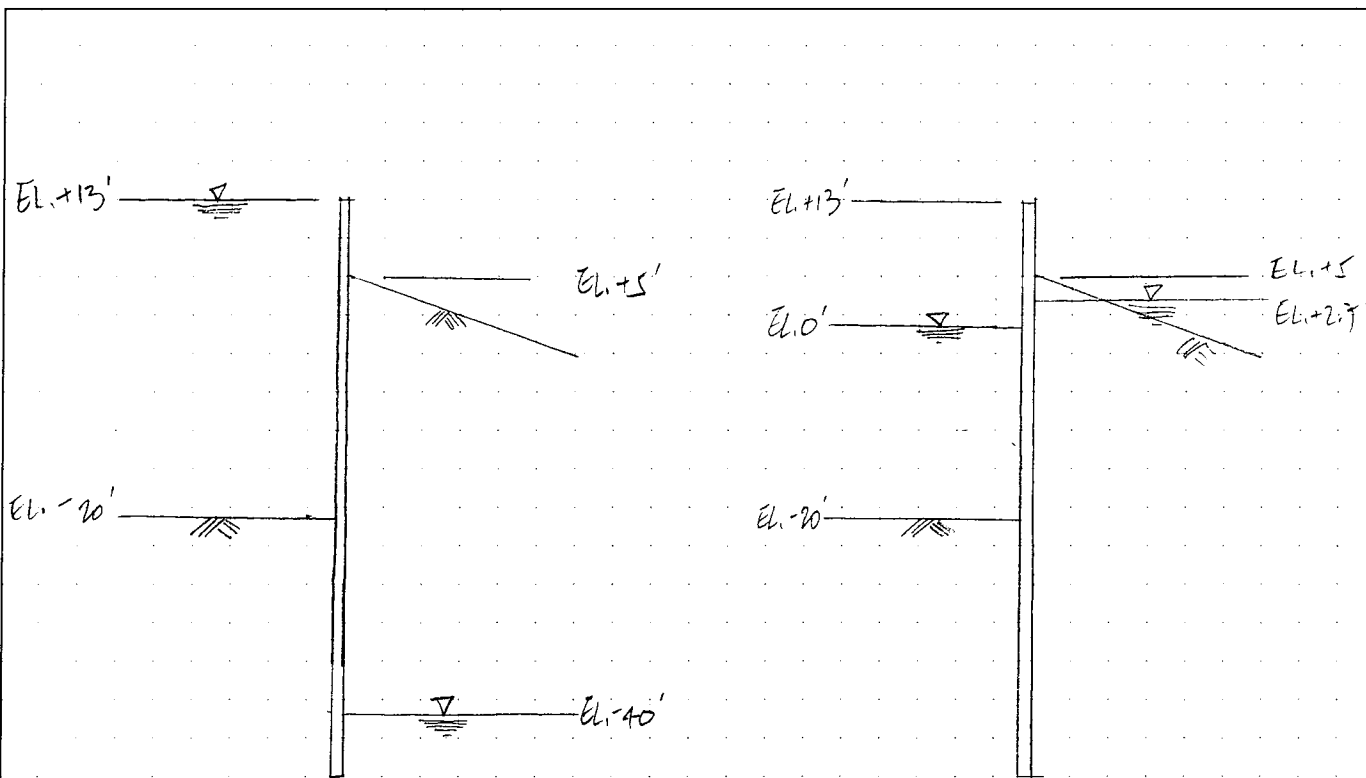


E. Cantilever King Pile Wall  
Final Configuration



E. Cantilever King Pile Wall  
While Bringing in the Ship

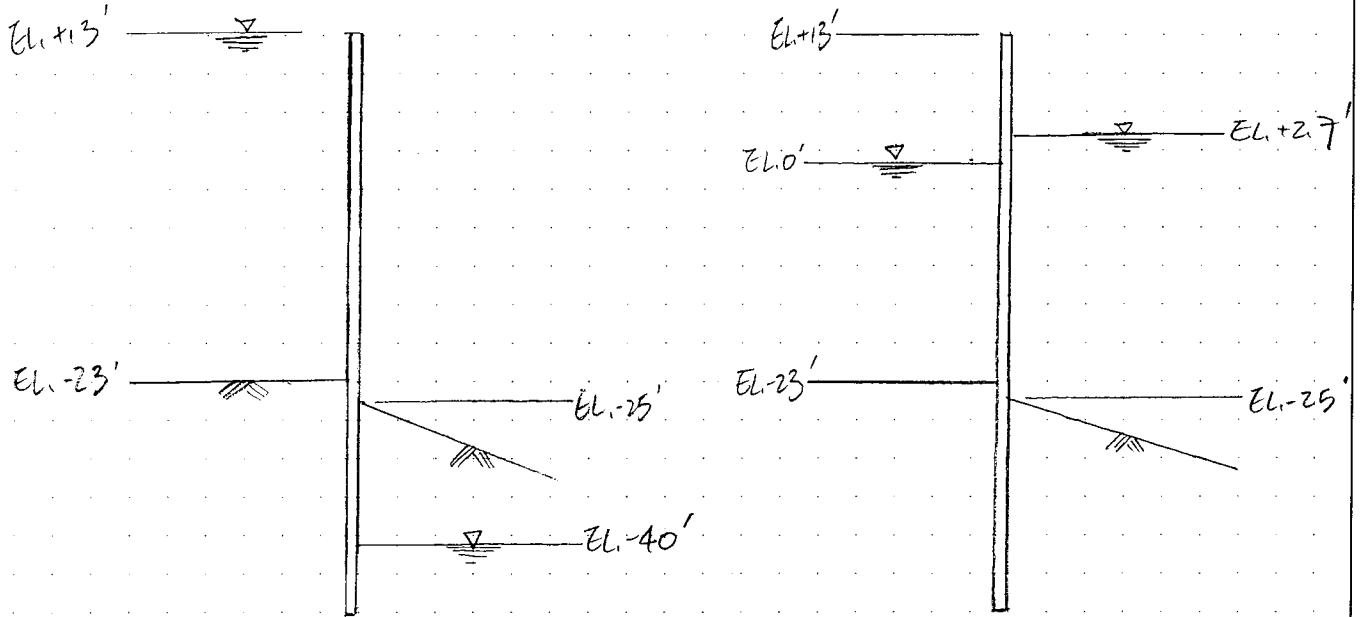
JOB TITLE USS Texas Battleship (W13)  
 JOB NO. 60188085 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR IK DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE \_\_\_\_\_ SHEET NO. 6 OF \_\_\_\_\_



F Cantilever King Pole Wall  
Final Configuration

F Cantilever King Pole Wall  
While Bring in the Ship

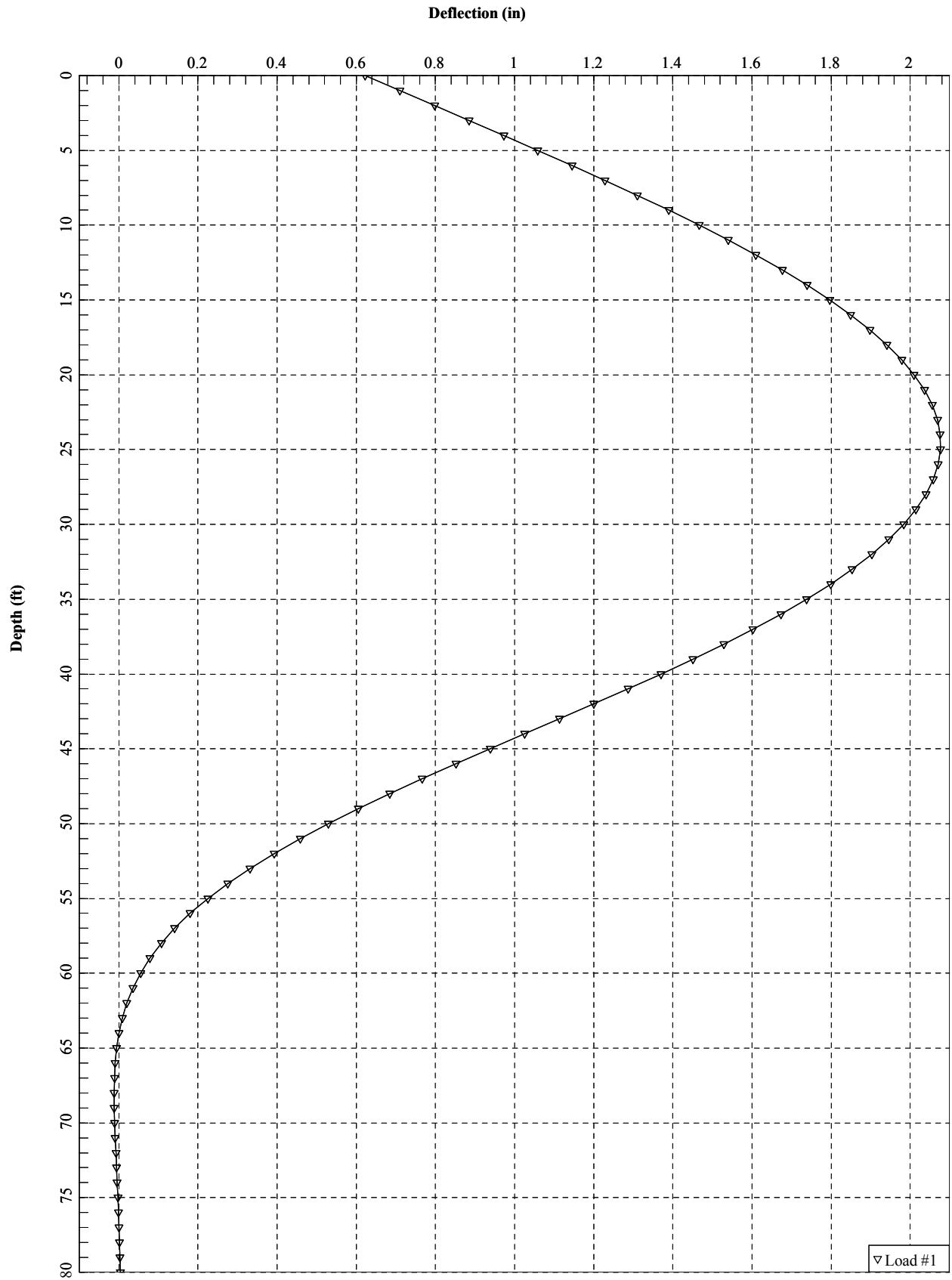
JOB TITLE USS Texas Battleship (W1.3)  
 JOB NO. 60188085 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR IK DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE \_\_\_\_\_ SHEET NO. 7 OF \_\_\_\_\_



⑦ Cantilever King Pile Wall  
Final Configuration

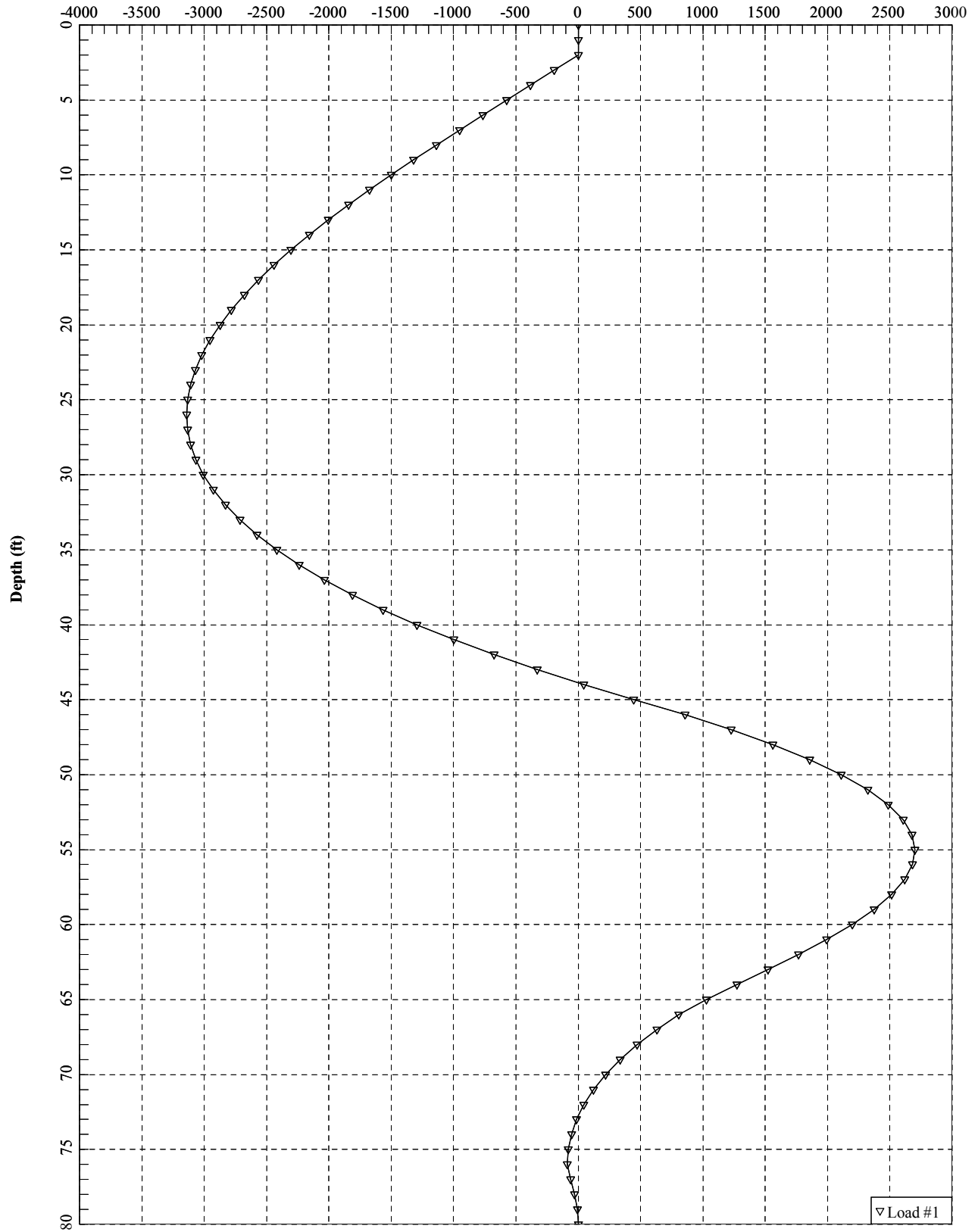
⑦ Cantilever King Pile Wall  
While Bringing in the Ship

**Battleship Texas, Alt. 1.3, Section A, Before Bringing In Ship**



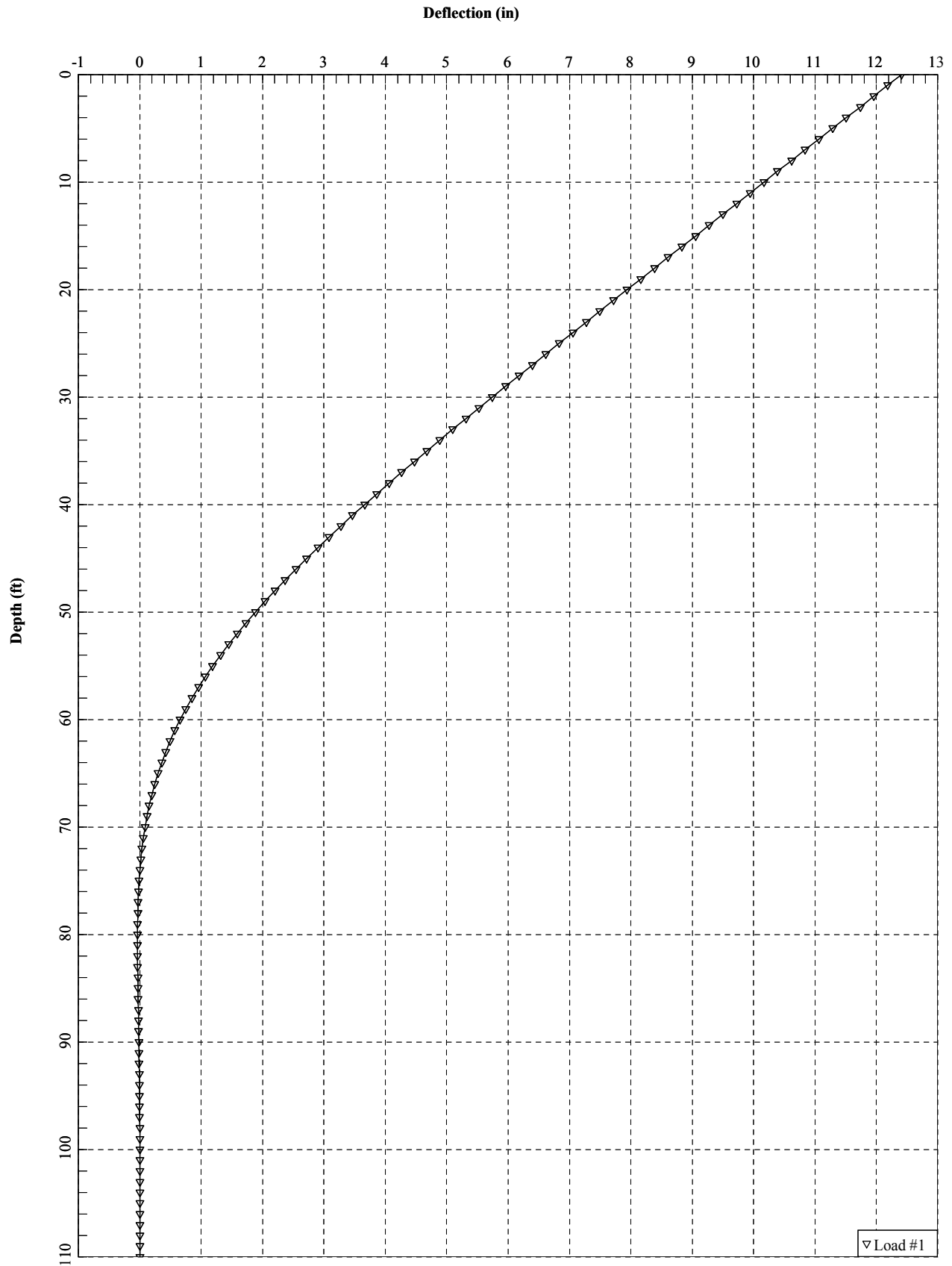
**Battleship Texas, Alt. 1.3, Section A, Before Bringing In Ship**

**Bending Moment (in-kips)**



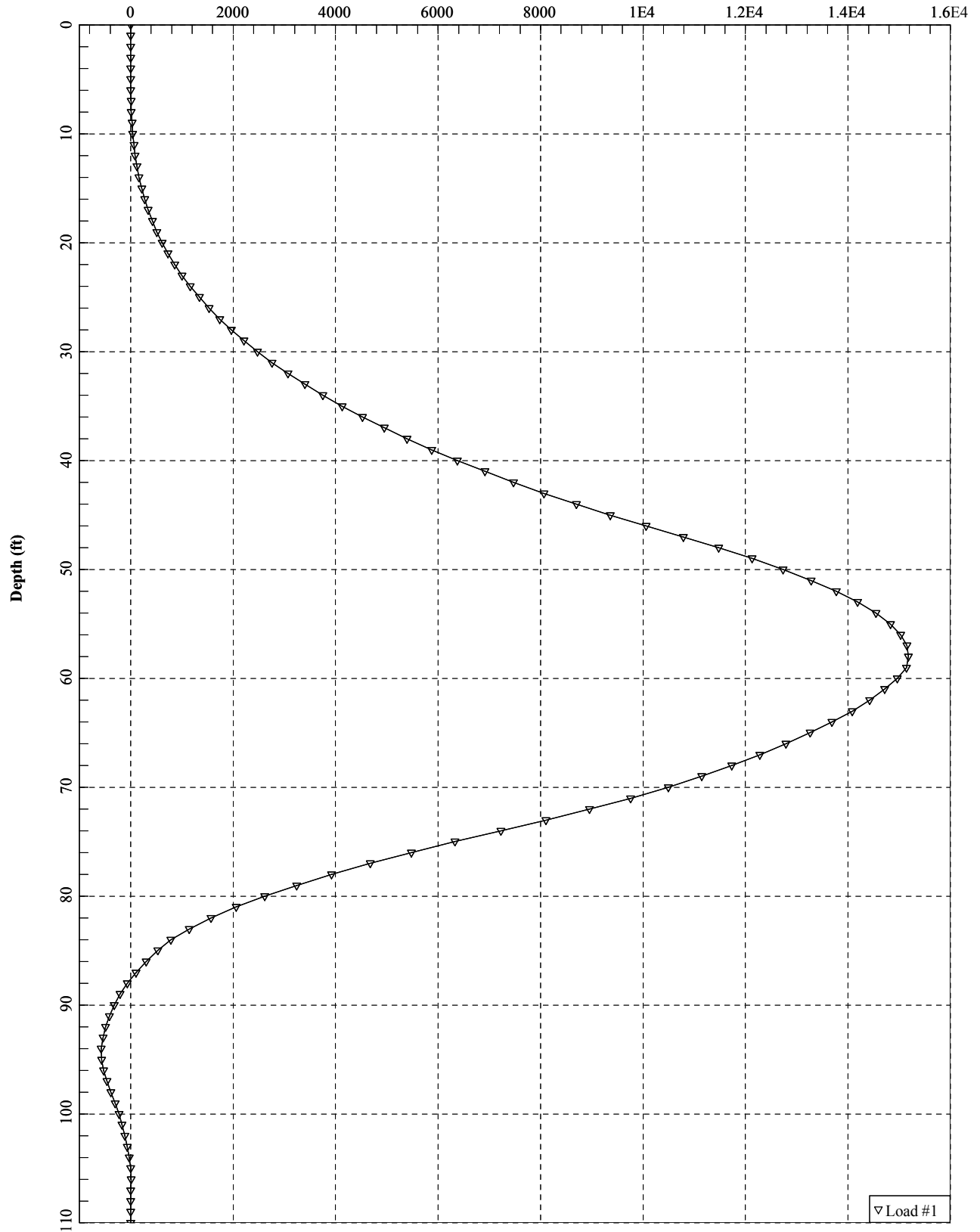


**Battleship Texas, Alt. 1.3, Section C, After Dredging**

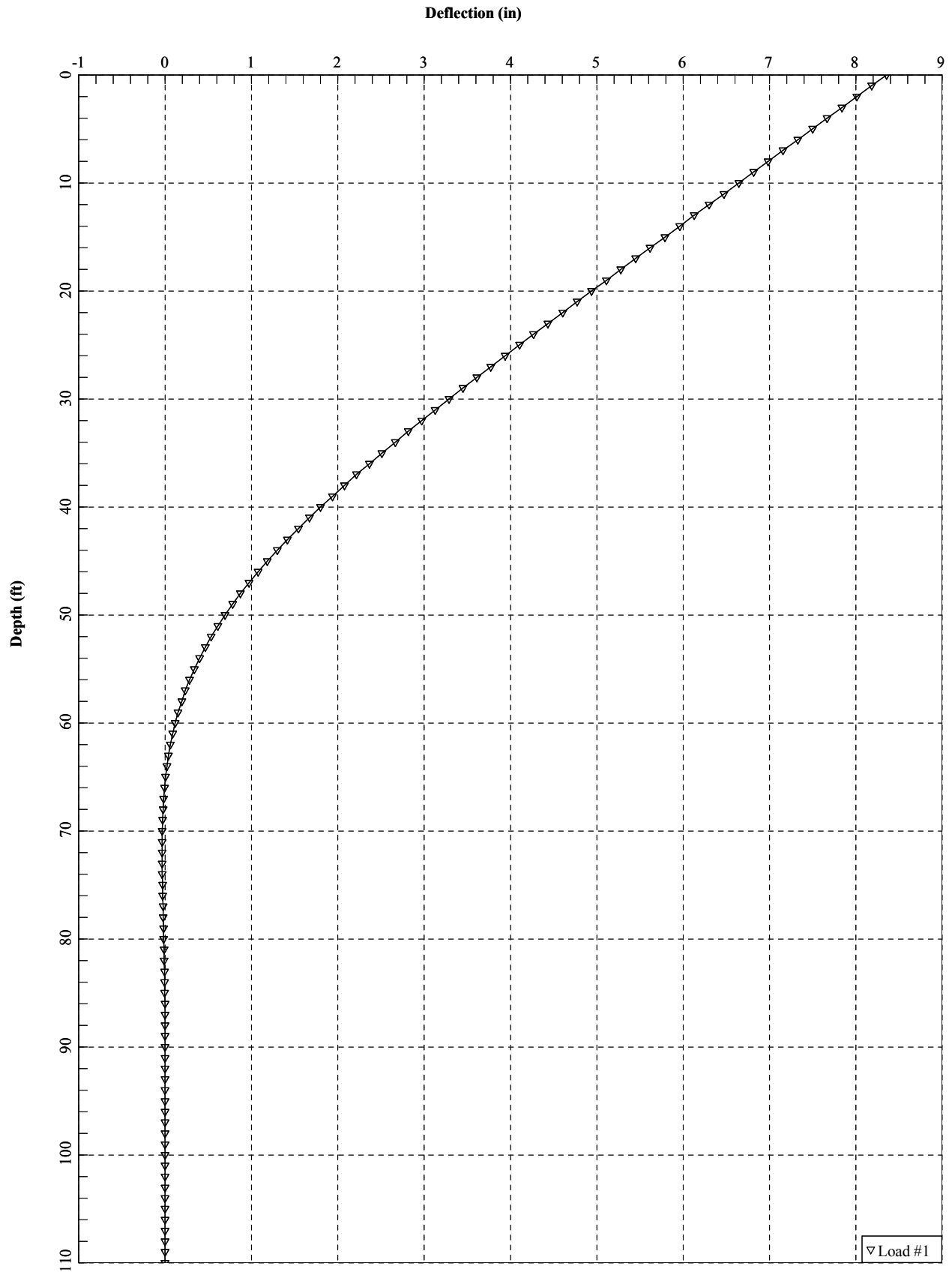


Battleship Texas, Alt. 1.3, Section C, After Dredging

Bending Moment (in-kips)

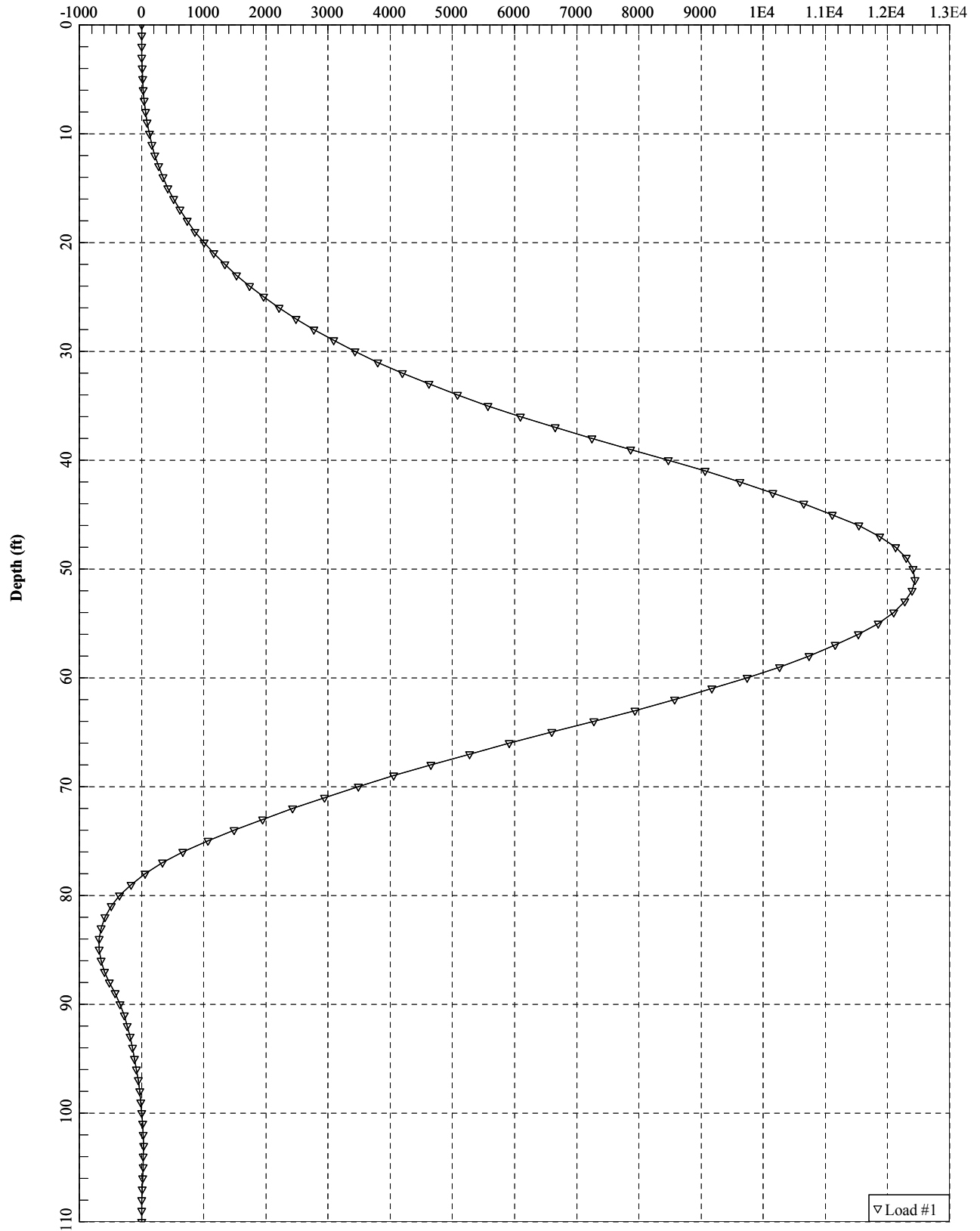


**Battleship Texas, Alt. 1.3, Section E', Final Configuration**

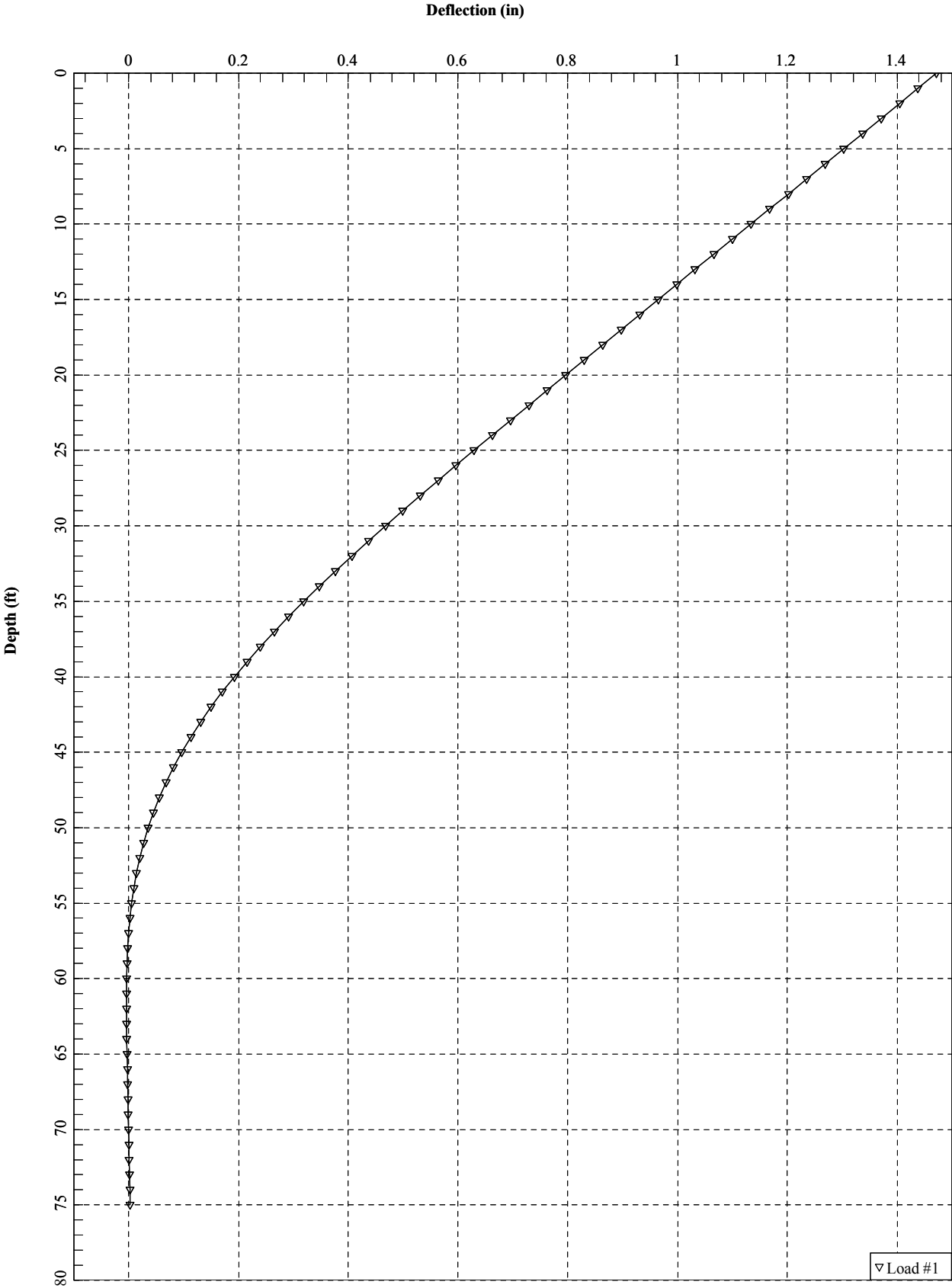


**Battleship Texas, Alt. 1.3, Section E', Final Configuration**

**Bending Moment (in-kips)**

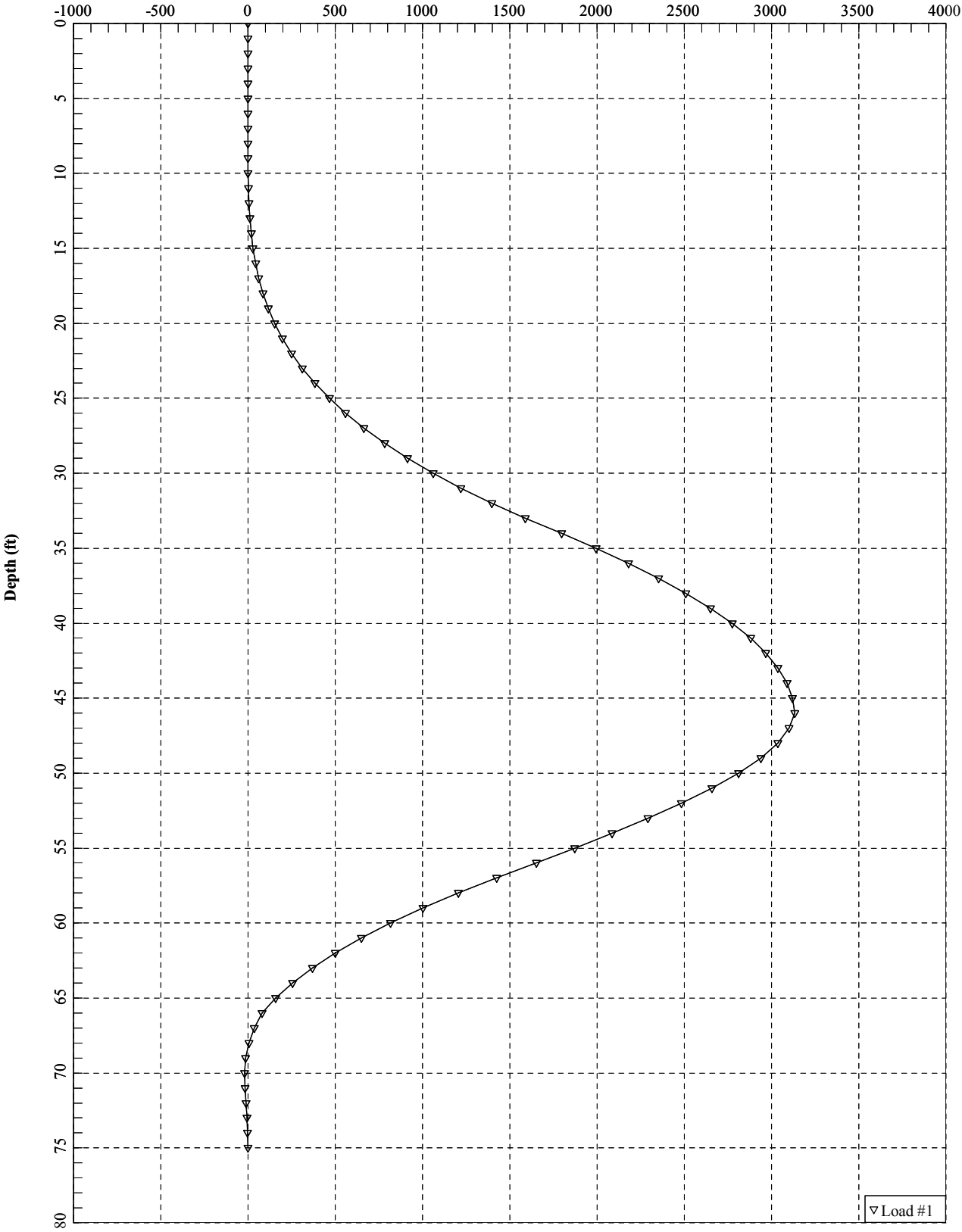


Battleship Texas, Alt. 1.3, Section F, While Bringing In Ship



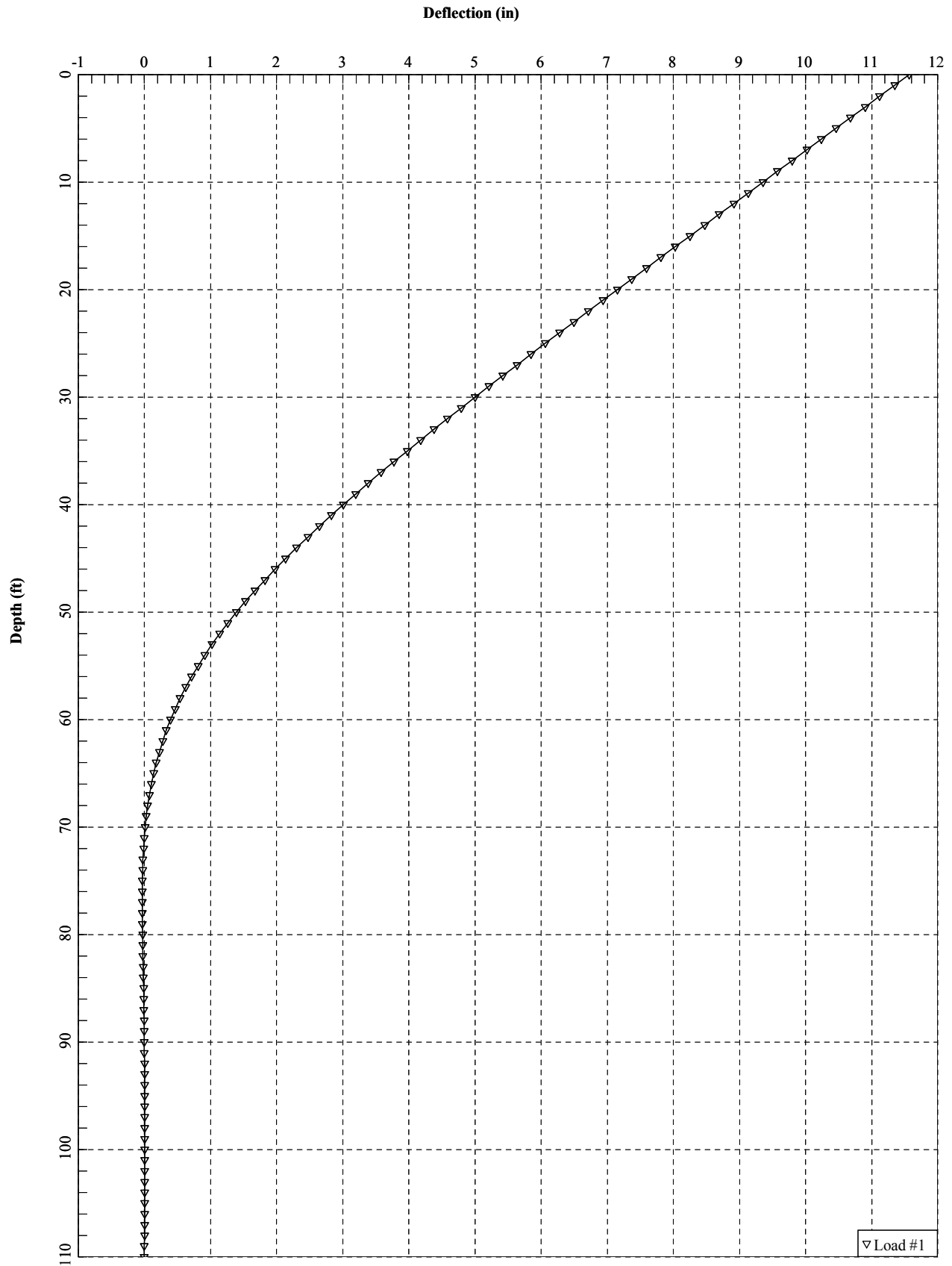
Battleship Texas, Alt. 1.3, Section F, While Bringing In Ship

Bending Moment (in-kips)



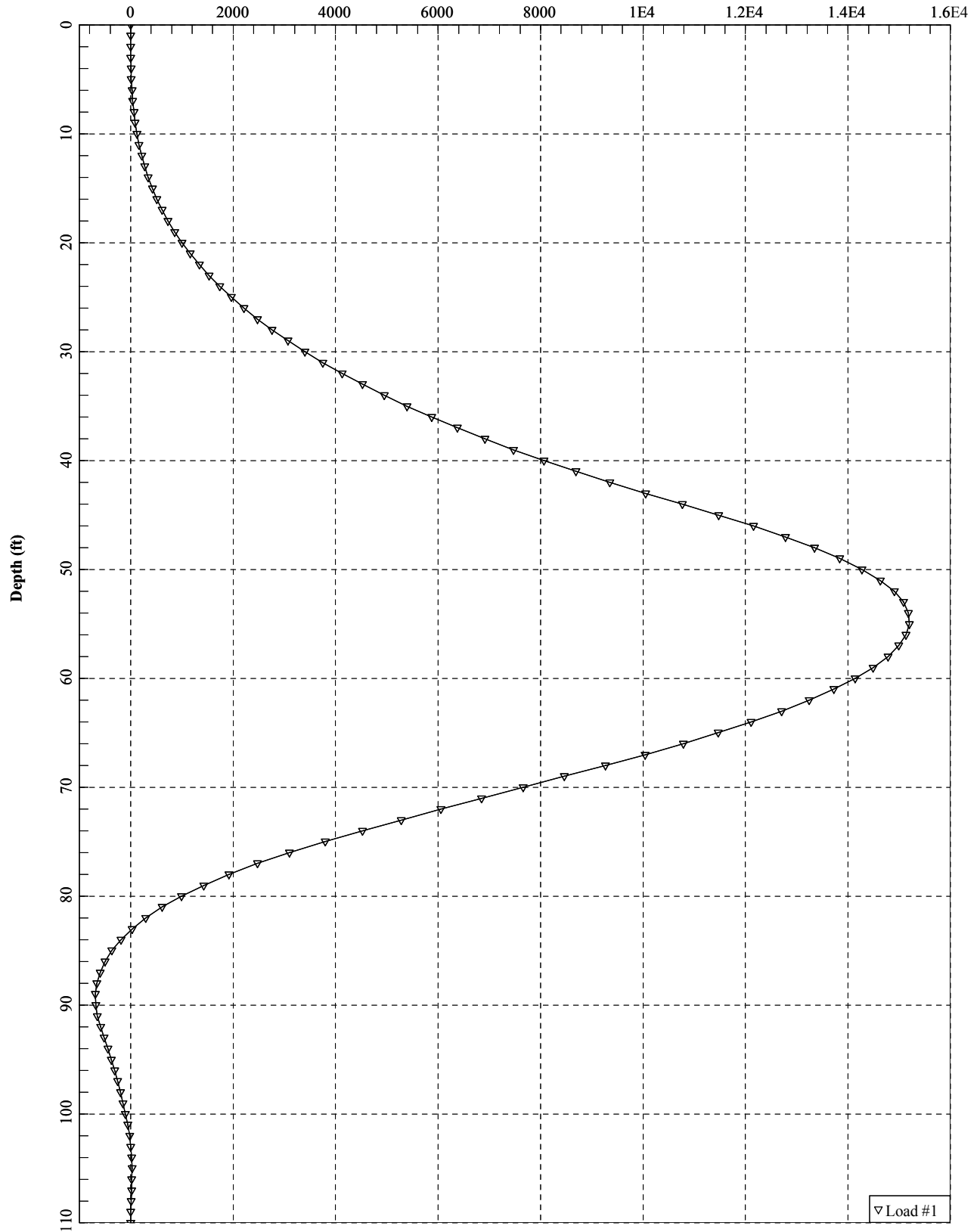
▽ Load #1

**Battleship Texas, Alt. 1.3, Section G, Final Configuration**



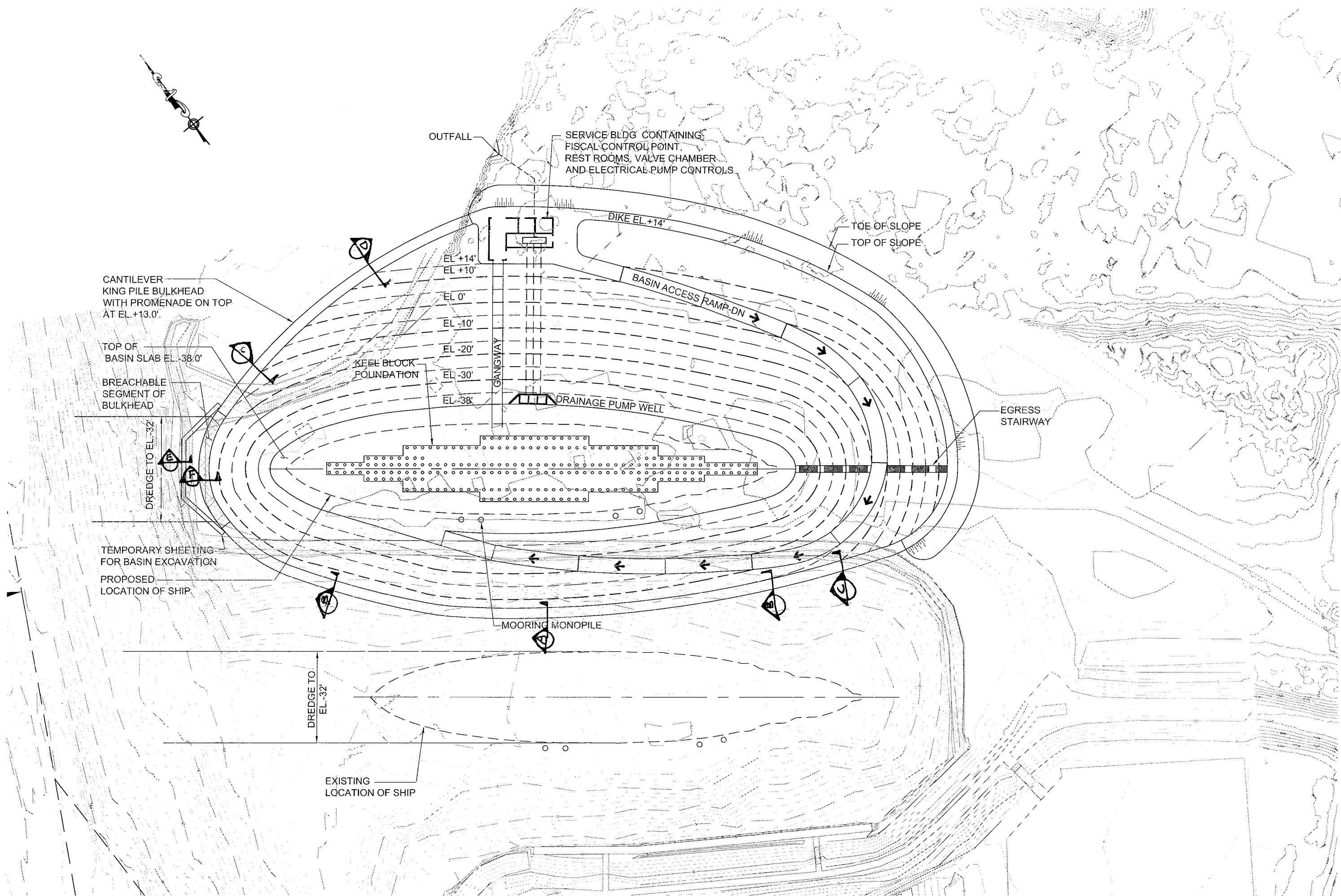
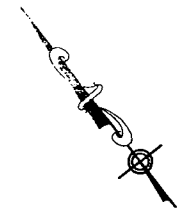
**Battleship Texas, Alt. 1.3, Section G, Final Configuration**

**Bending Moment (in-kips)**

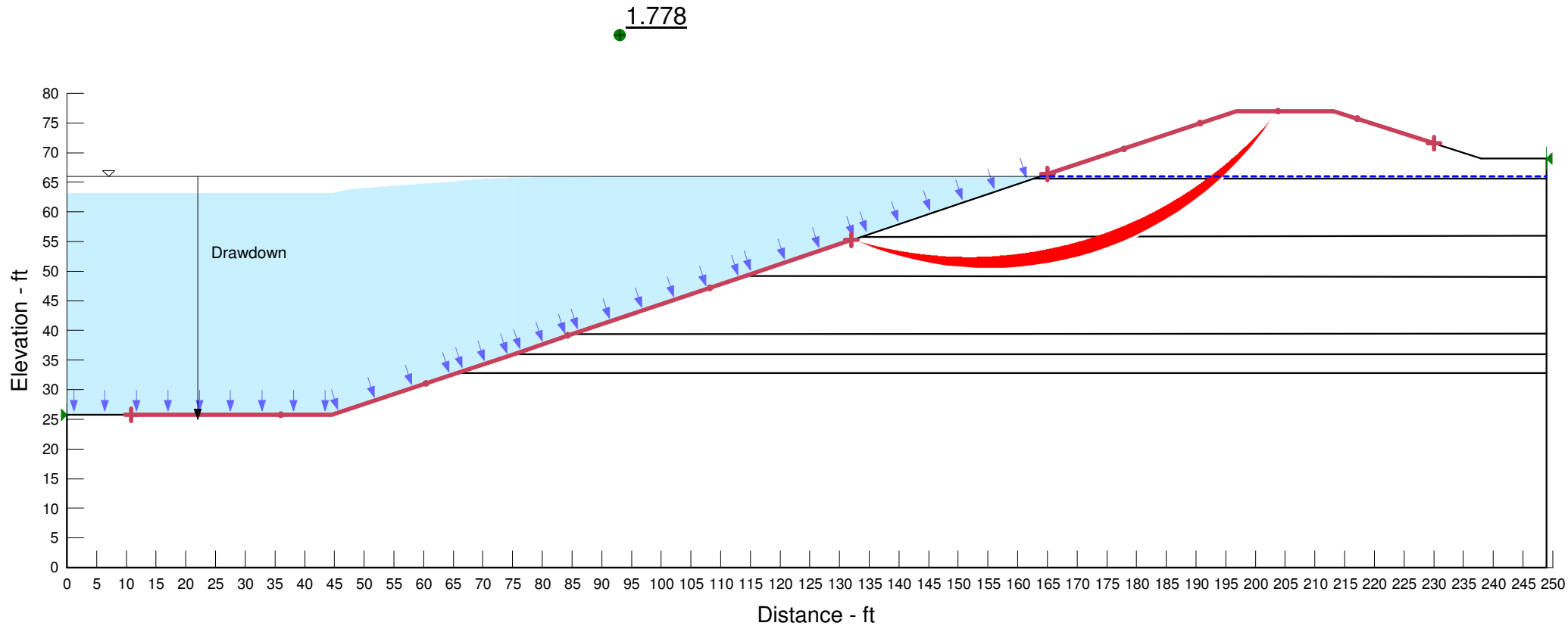




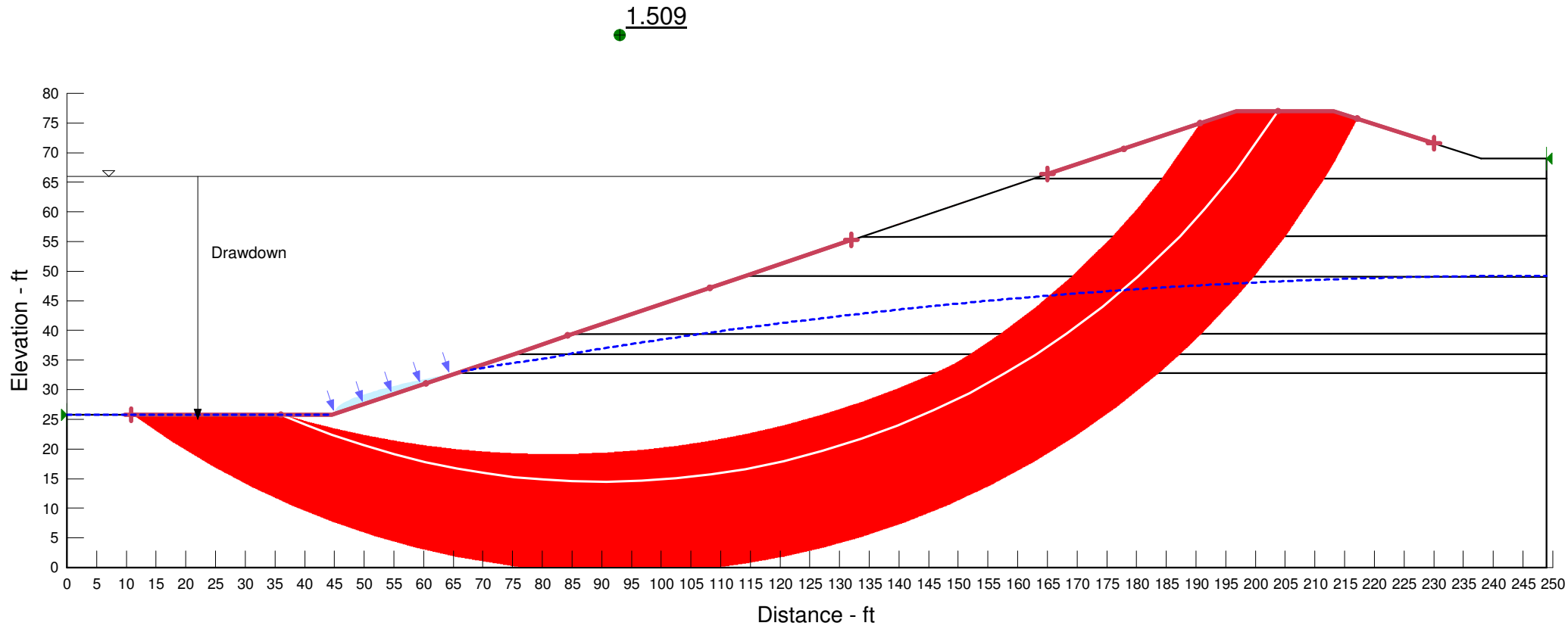
**APPENDIX D**  
**ALTERNATIVE 2.2B**



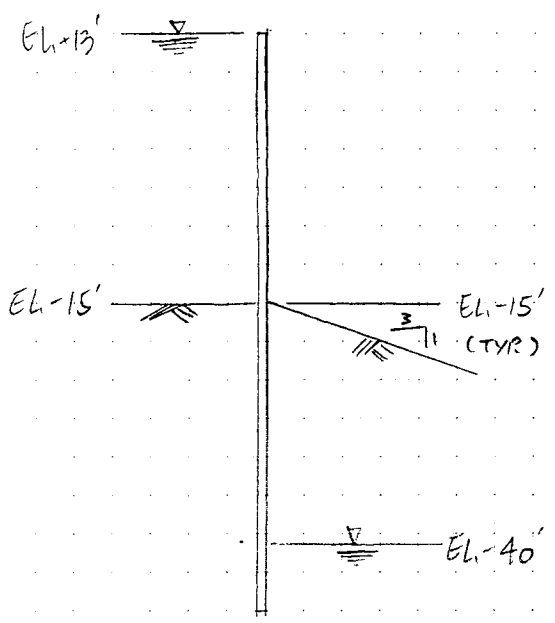
# Alternative 2.2B - Short Term Slope Stability



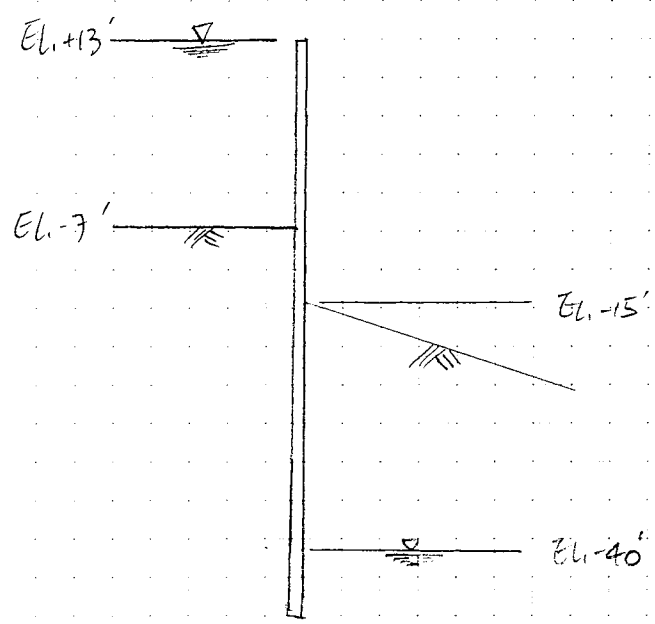
# Alternative 2.2B - Long Term Slope Stability



JOB TITLE USS Texas Battleship (WZ.2B)  
 JOB NO. 601880 85 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR IC DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE 1:20 SHEET NO. 1 OF \_\_\_\_\_

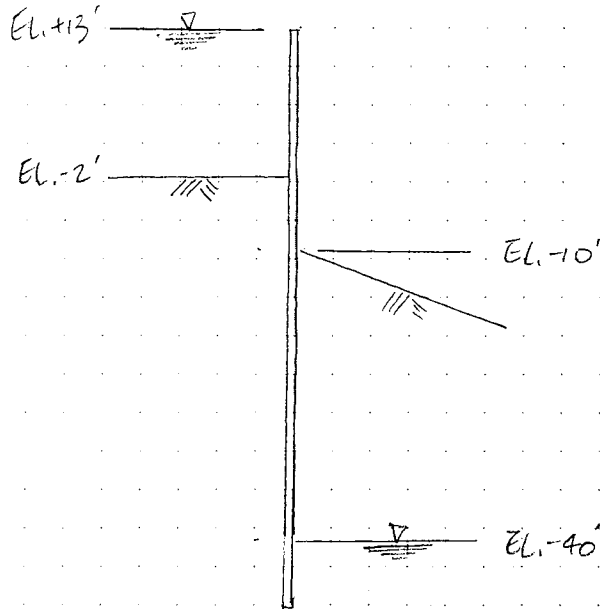


**(A) Final Configuration**

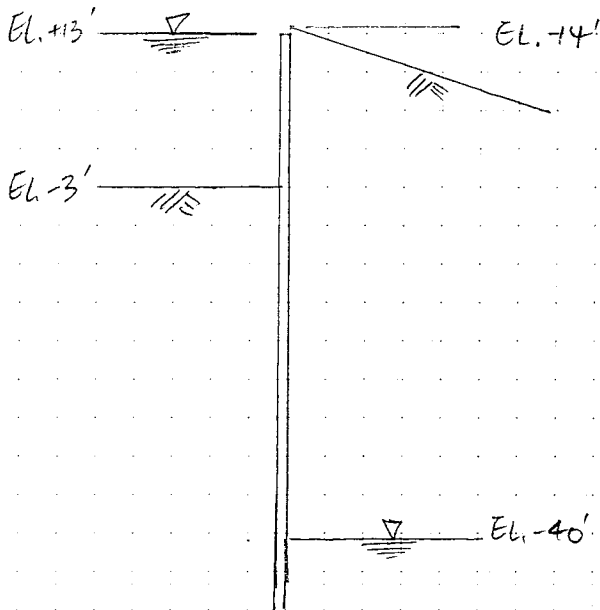


**(B) Final Configuration**

JOB TITLE USS Texas Battleship (W2.2B)  
 JOB NO. 60182085 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR IC DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE 1:20 SHEET NO. 2 OF \_\_\_\_\_

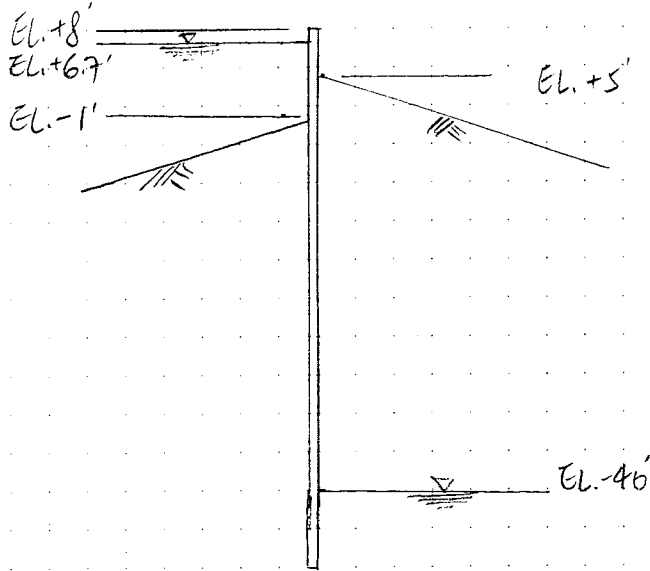


② Final Configuration

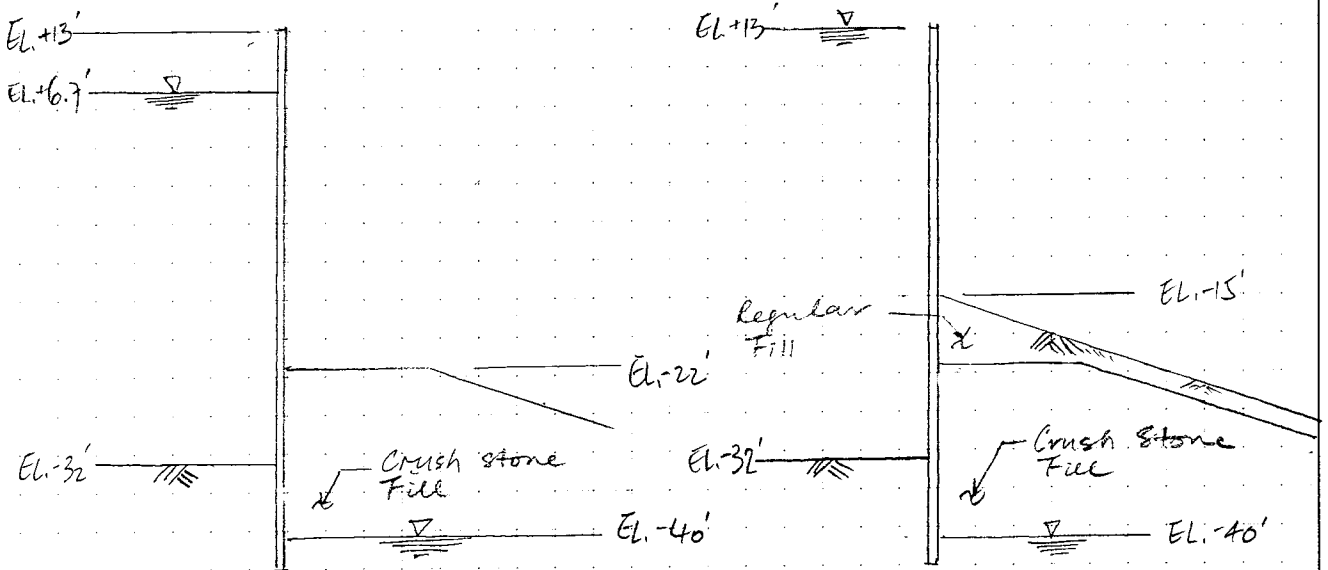


③ Final Configuration

JOB TITLE USS Texas Battleship (W2, 2B)  
 JOB NO. 6018025 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR IC DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE 1:20 SHEET NO. 3 OF \_\_\_\_\_



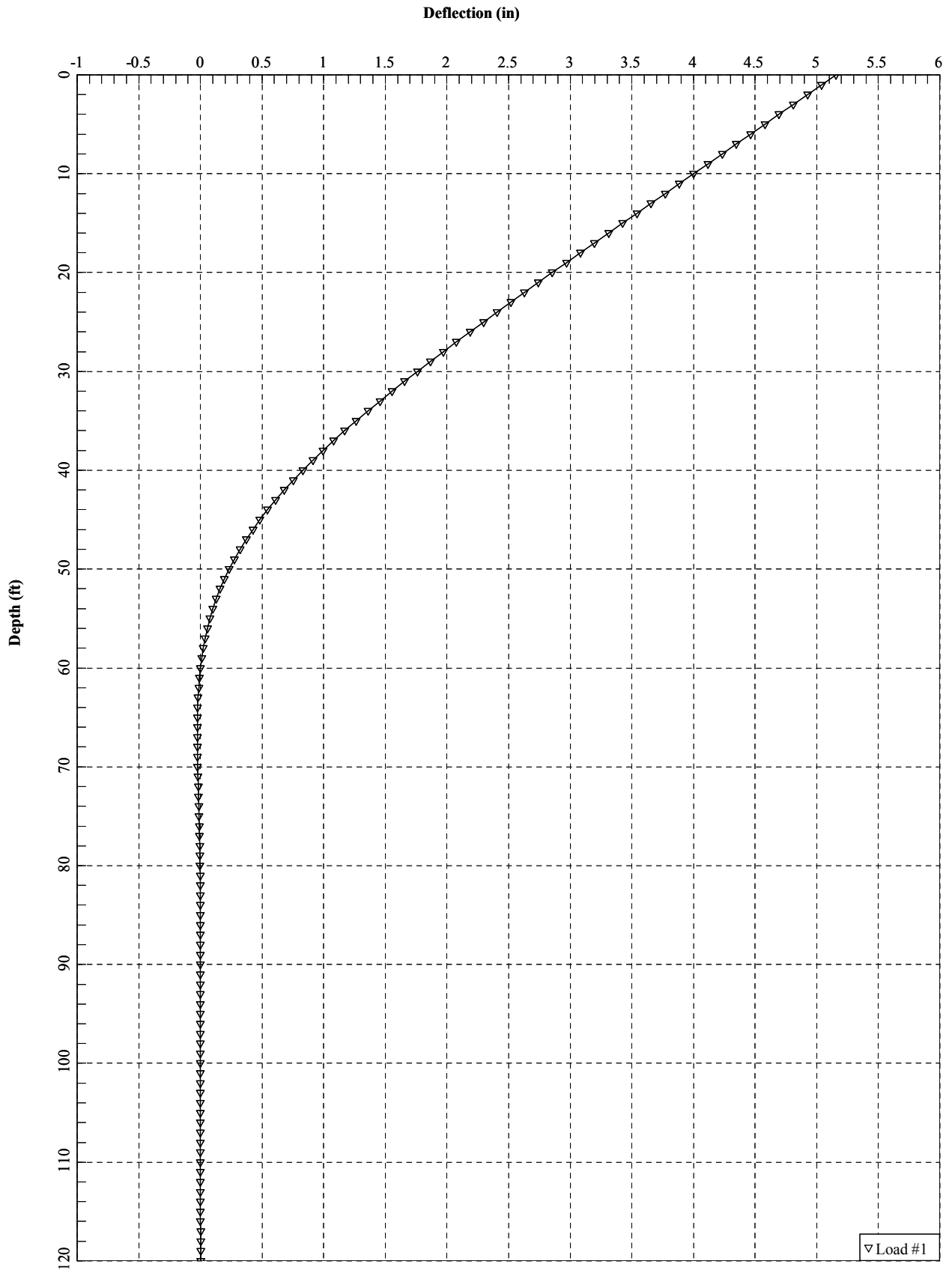
(E) Temp Sheeting Before dredging



(F) After Bronging in the Ship

(F) Final Configuration

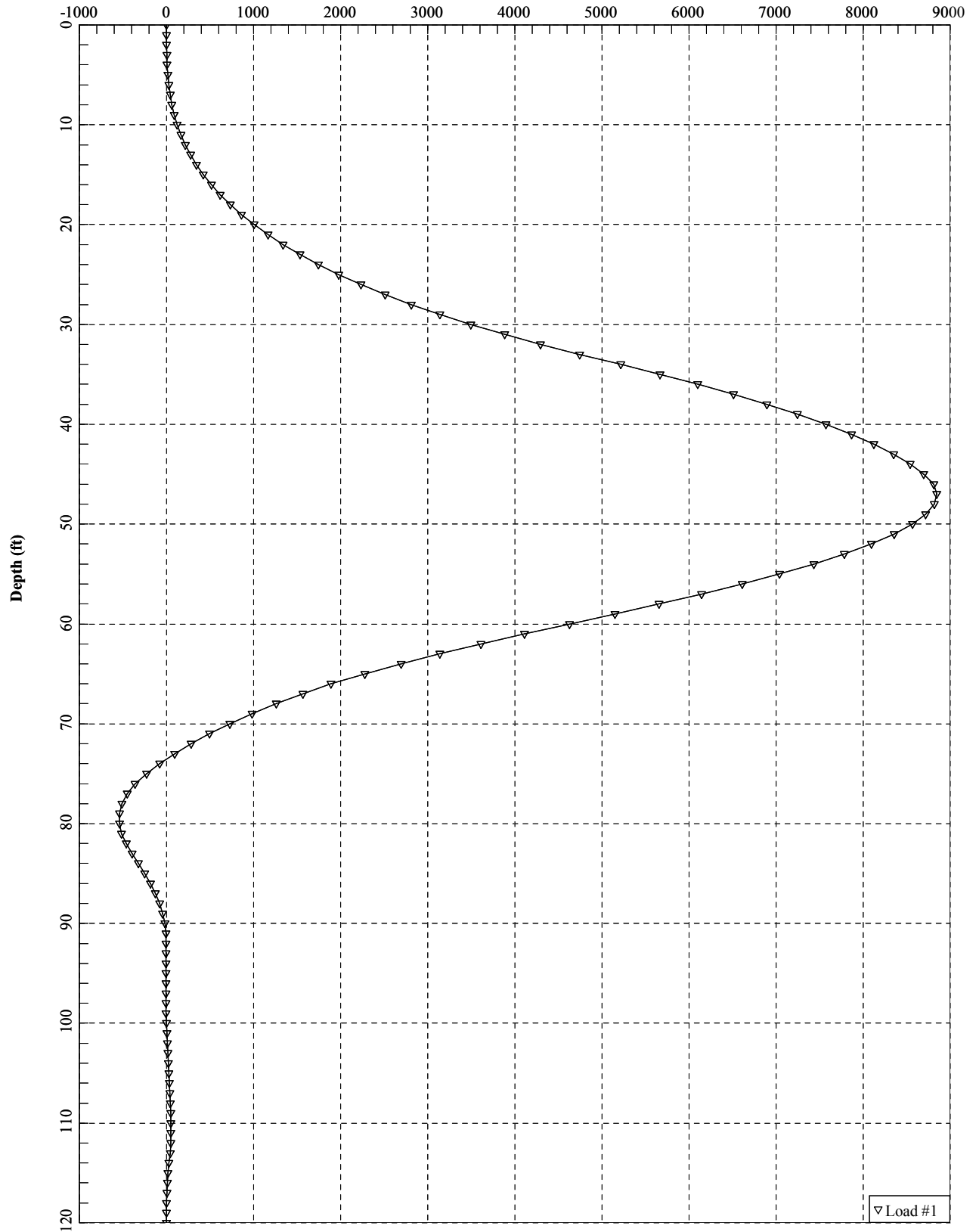
**Battleship Texas, Alt. 2-2B, Section B, Final Config.**



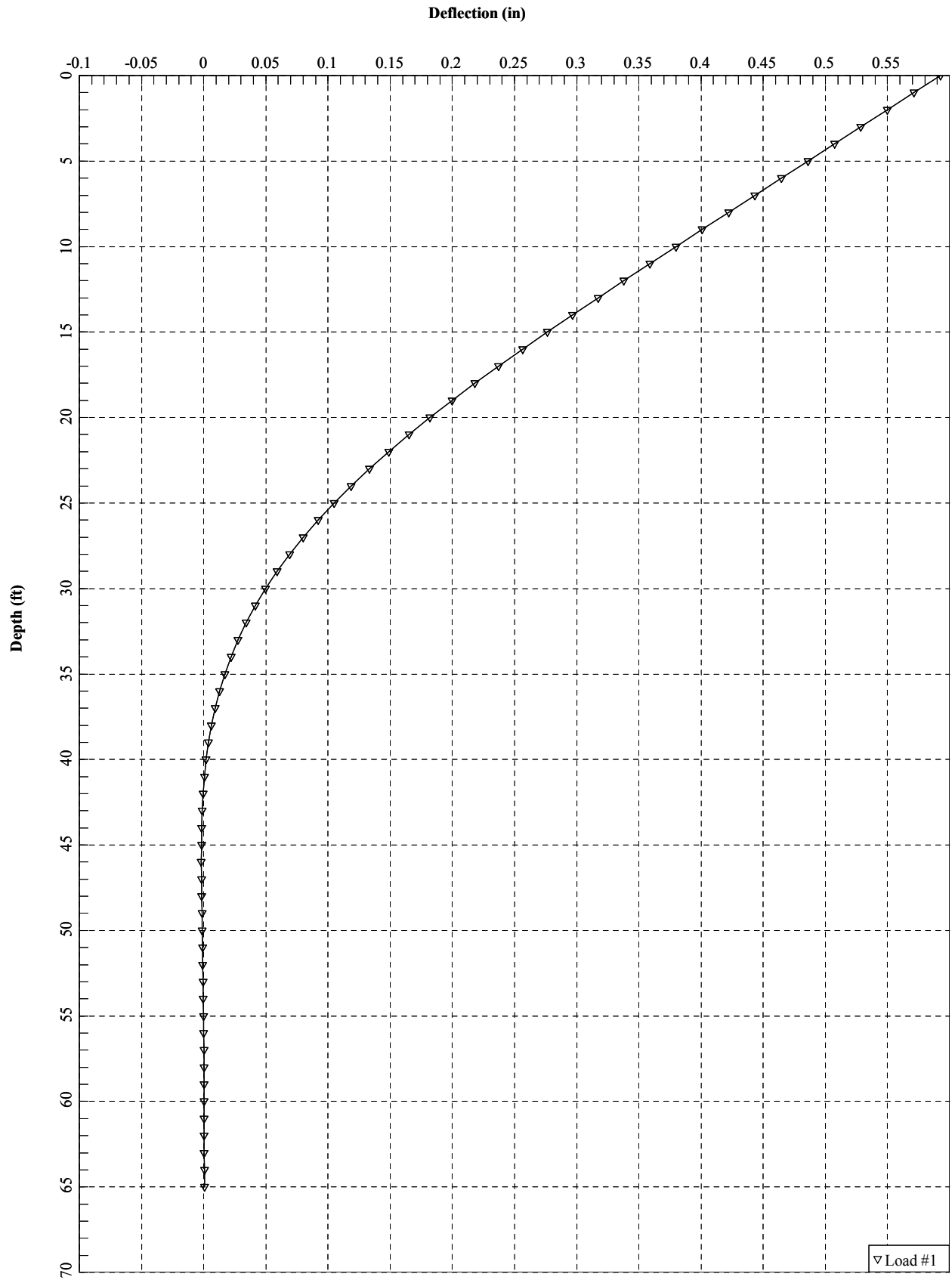


**Battleship Texas, Alt. 2-2B, Section B, Final Config.**

**Bending Moment (in-kips)**

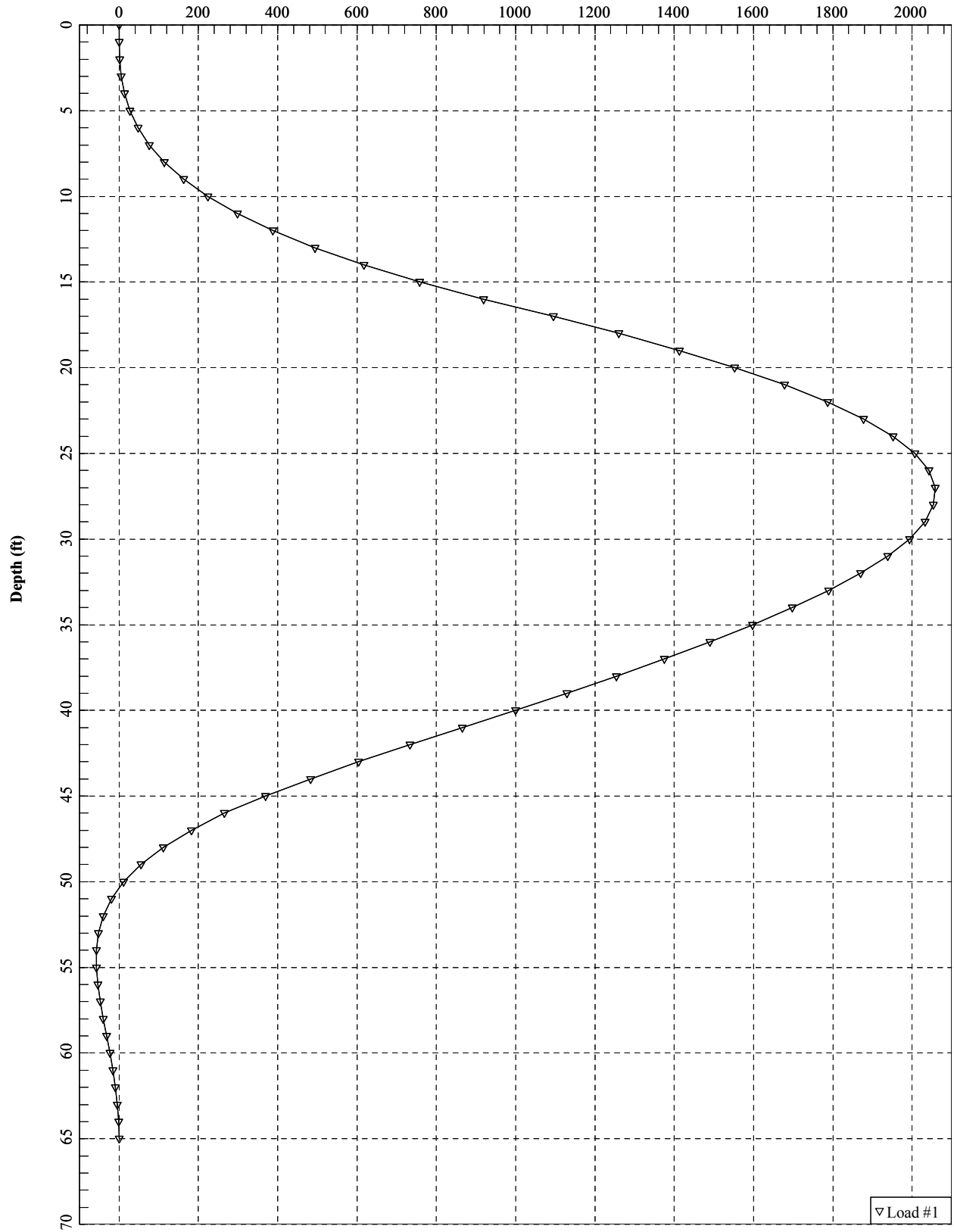


Battleship Texas, Alt. 2-2B, Section D, Final Config.

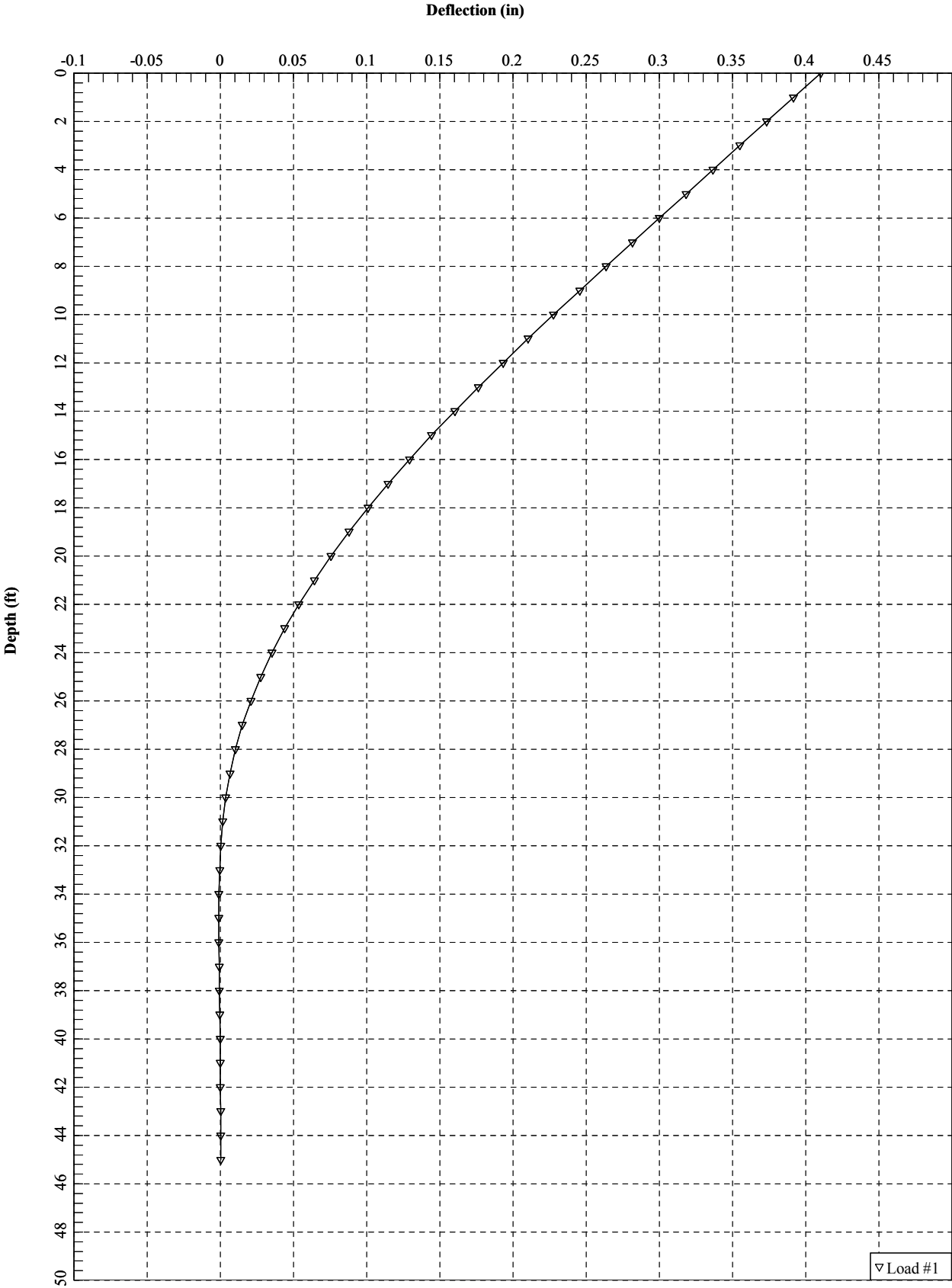


Battleship Texas, Alt. 2-2B, Section D, Final Config.

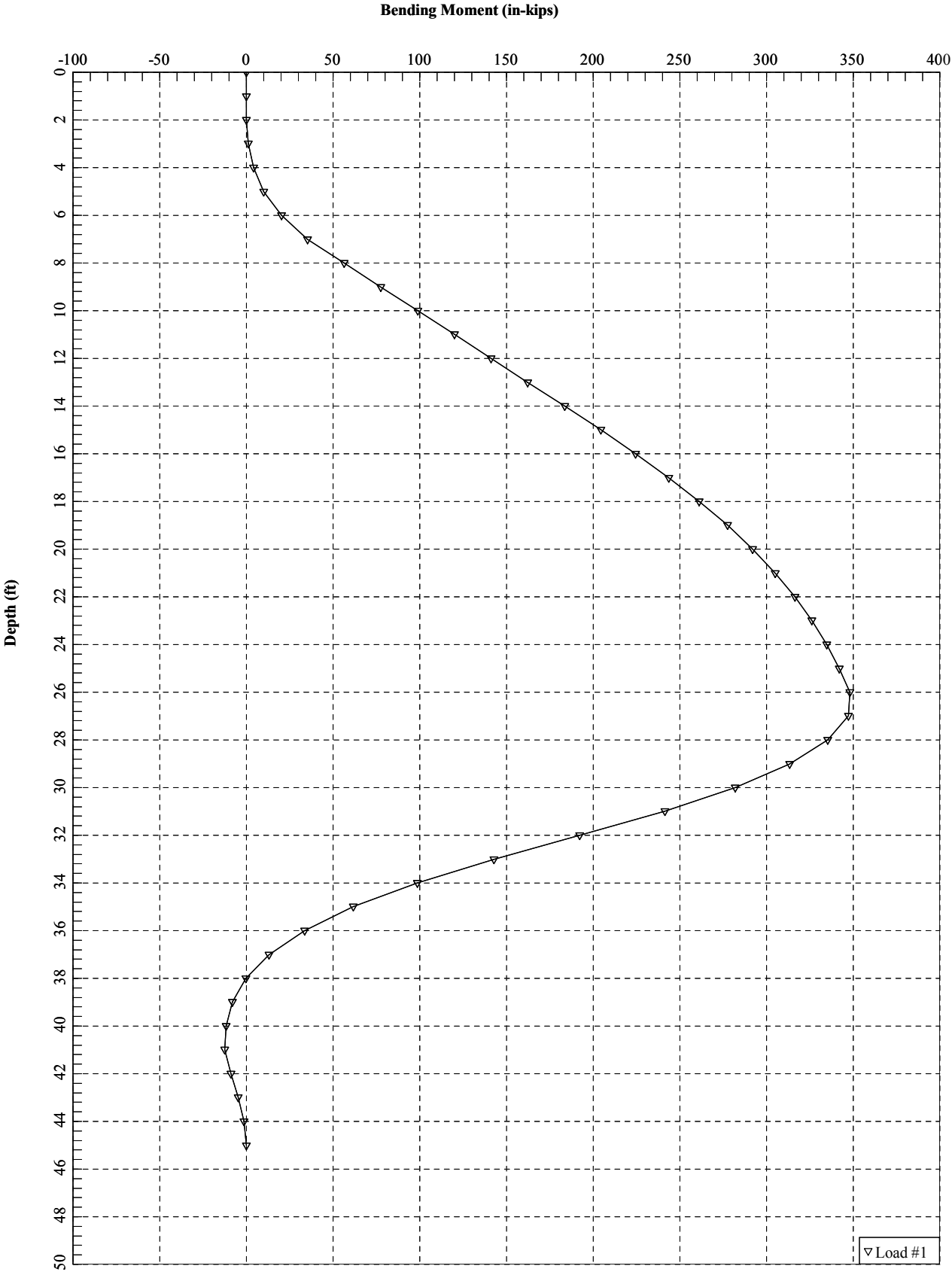
Bending Moment (in-kips)



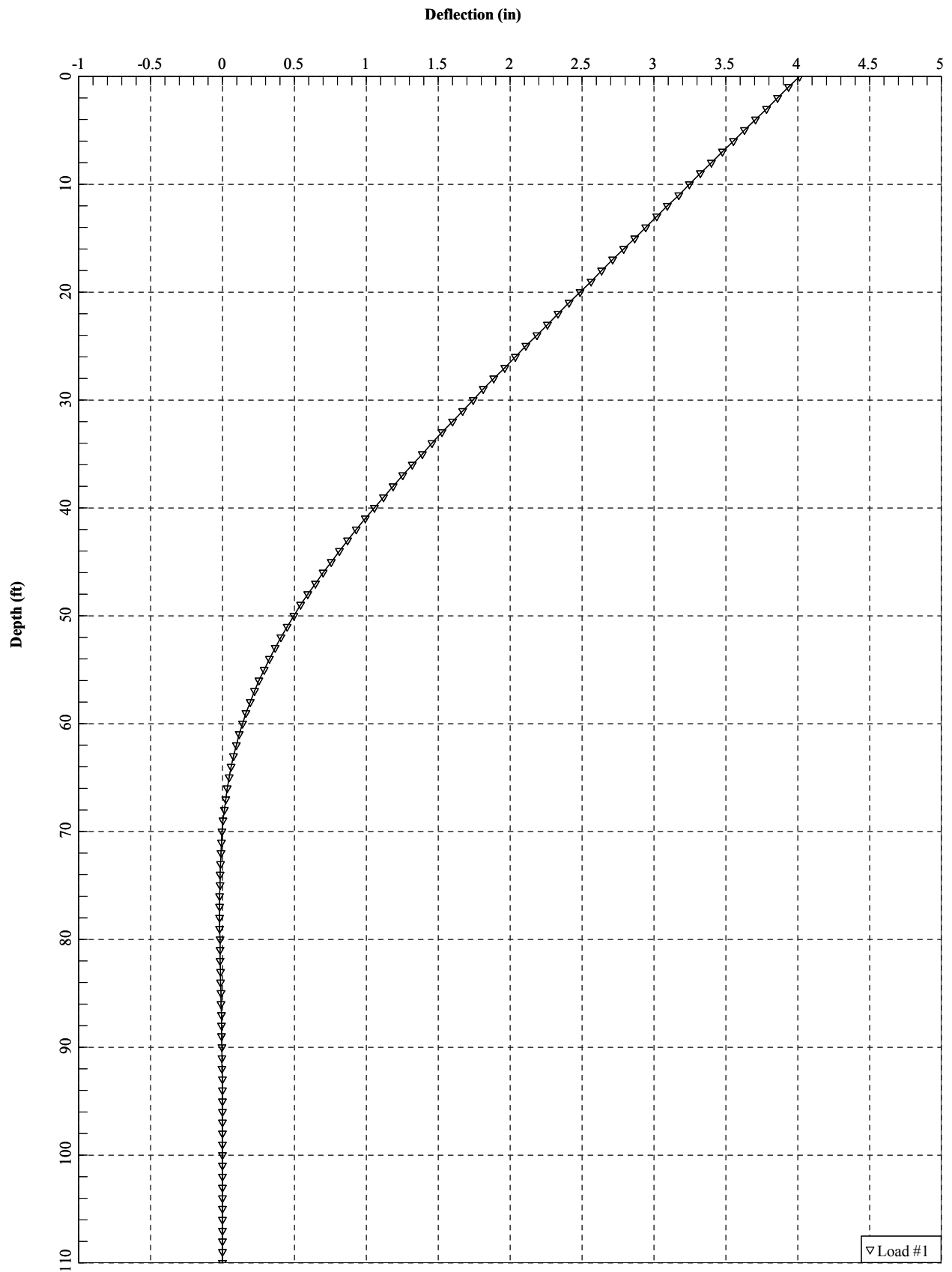
Battleship Texas, Alt. 2-2B, Section E, Temporary before Dredging



Battleship Texas, Alt. 2-2B, Section E, Temporary before Dredging

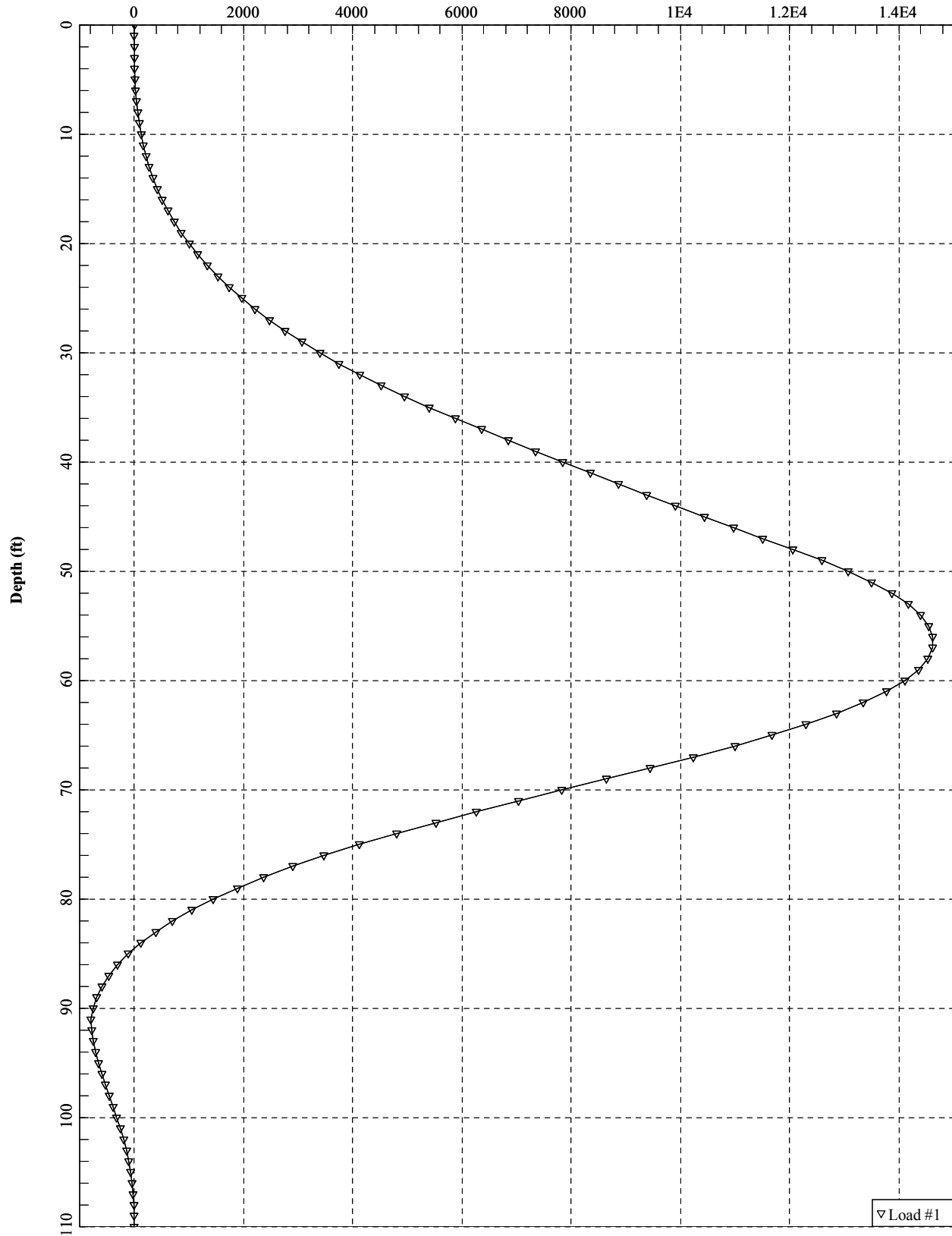


Battleship Texas, Alt. 2-2B, Section F, Final



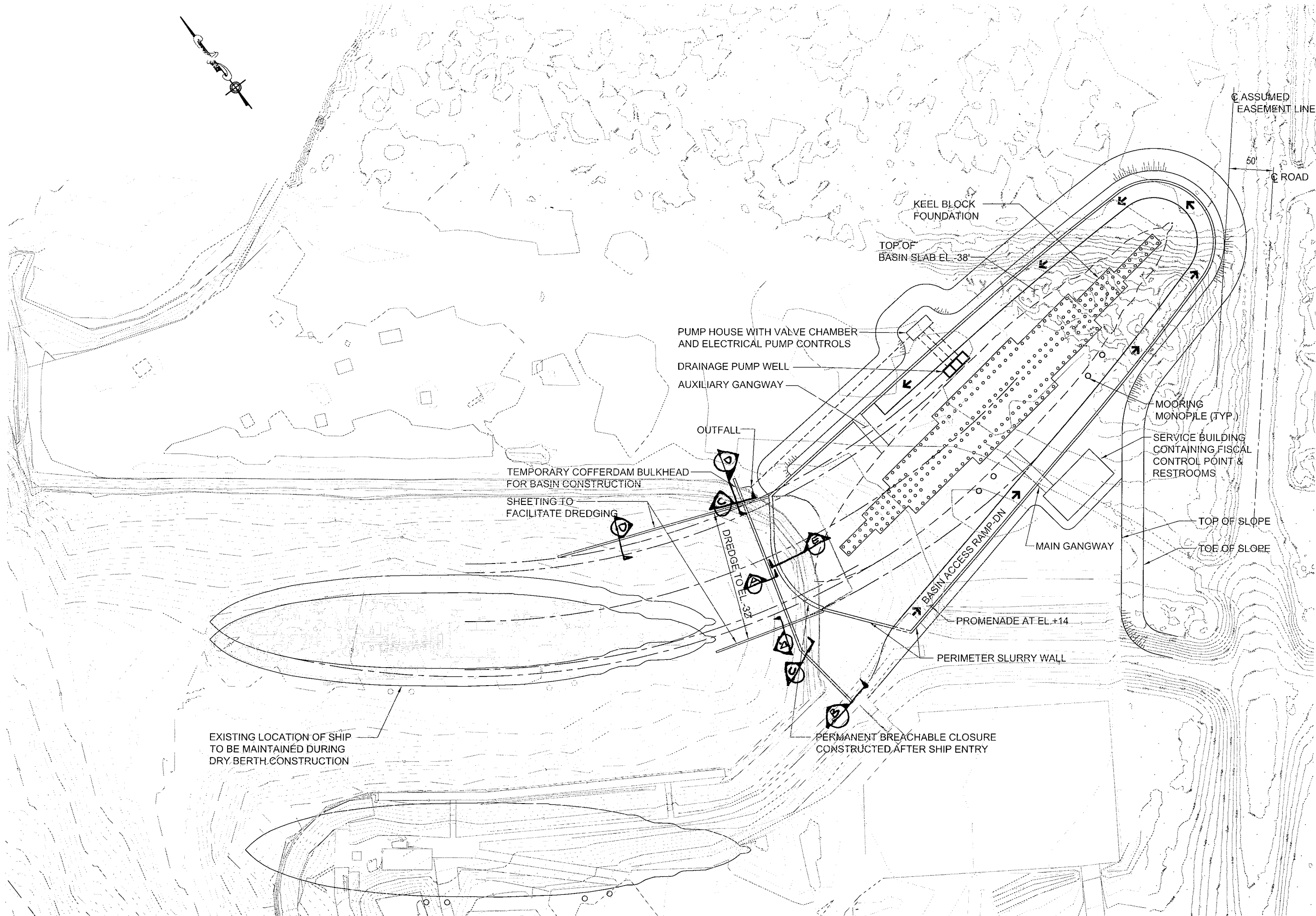
Battleship Texas, Alt. 2-2B, Section F, Final

Bending Moment (in-kips)

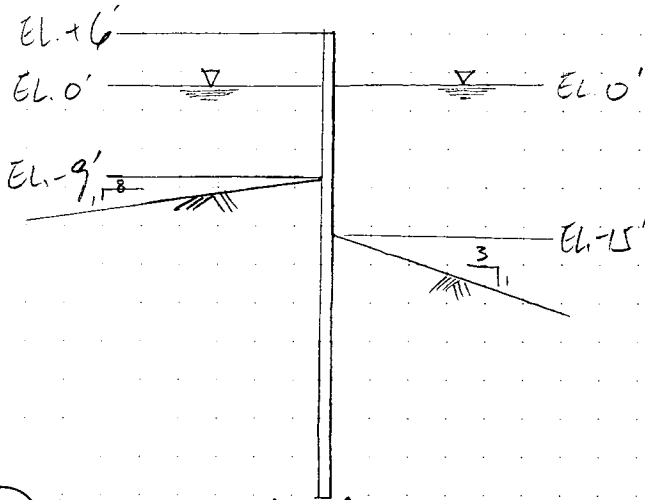


**APPENDIX E**  
**ALTERNATIVE 3.0**

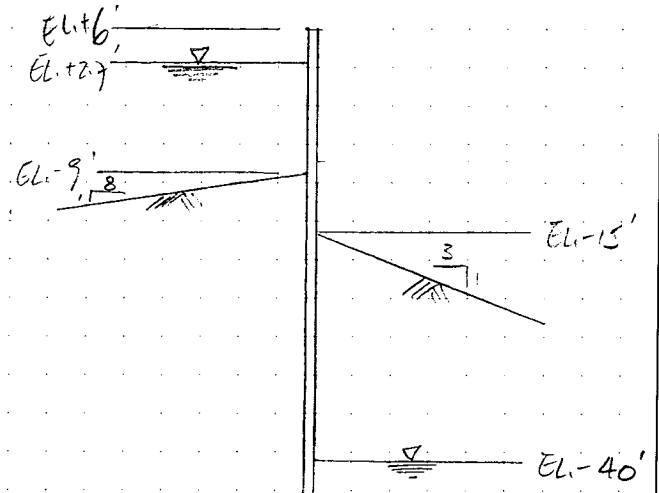




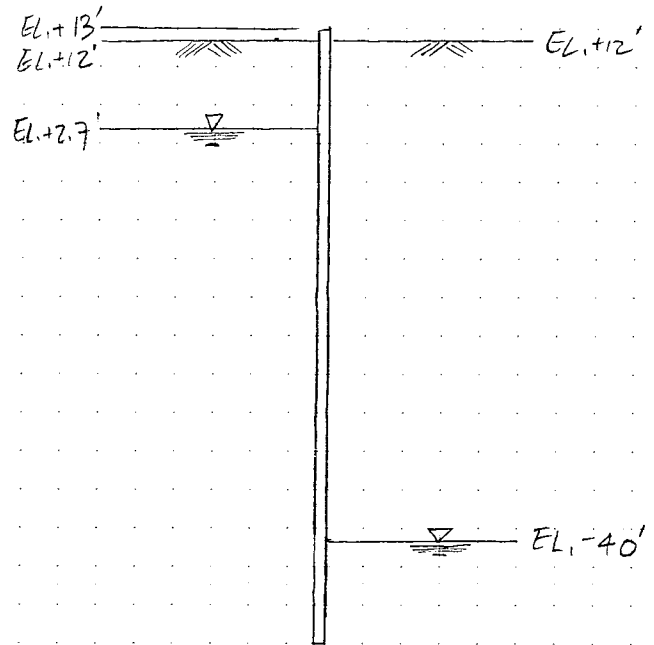
JOB TITLE USS Texas Battleship (W3.0)  
 JOB NO. 60188080 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR JK DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE \_\_\_\_\_ SHEET NO. 1 OF \_\_\_\_\_



**A** Temp. Bulkhead Before Dewatering  
 (NOT governing)

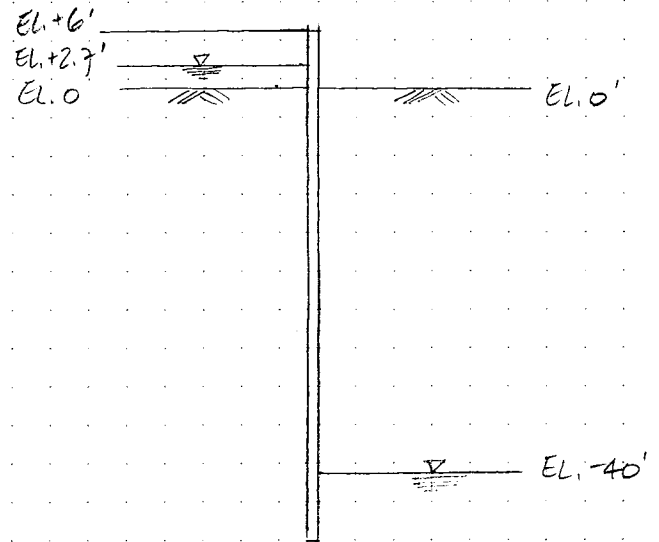


**A** Temp. Bulkhead After Dewatering



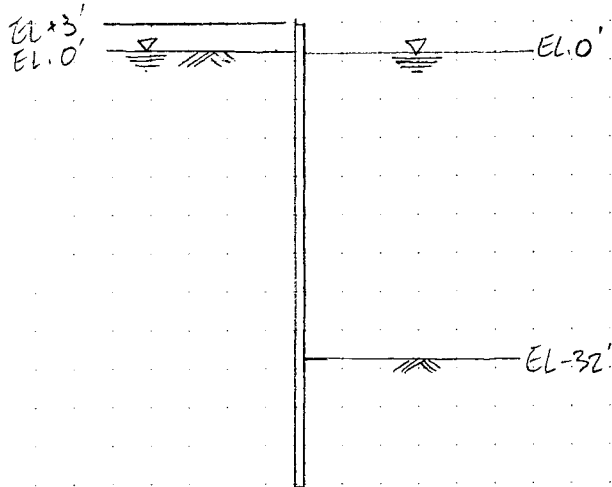
**B** Temp. Bulkhead After Dewatering

JOB TITLE USS Texas Battleship (W3.0)  
 JOB NO. 6018085 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR IK DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE \_\_\_\_\_ SHEET NO. 2 OF \_\_\_\_\_

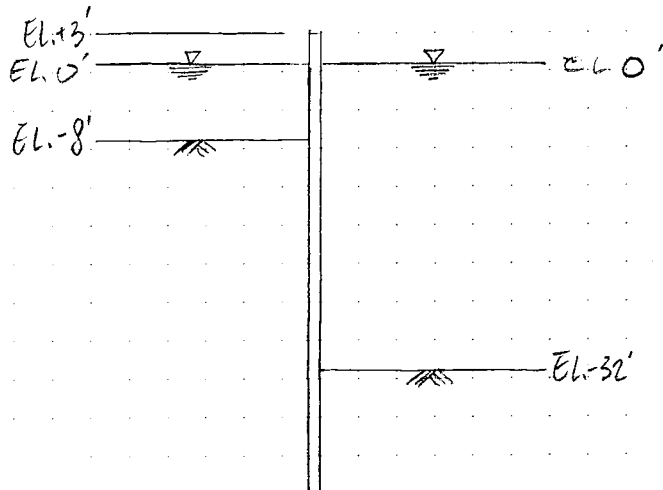


Ⓒ Temp. Bulkhead After Dewatering.

JOB TITLE USS Texas Battleship (W3.0)  
 JOB NO. 60182085 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR IK DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE \_\_\_\_\_ SHEET NO. 3 OF \_\_\_\_\_

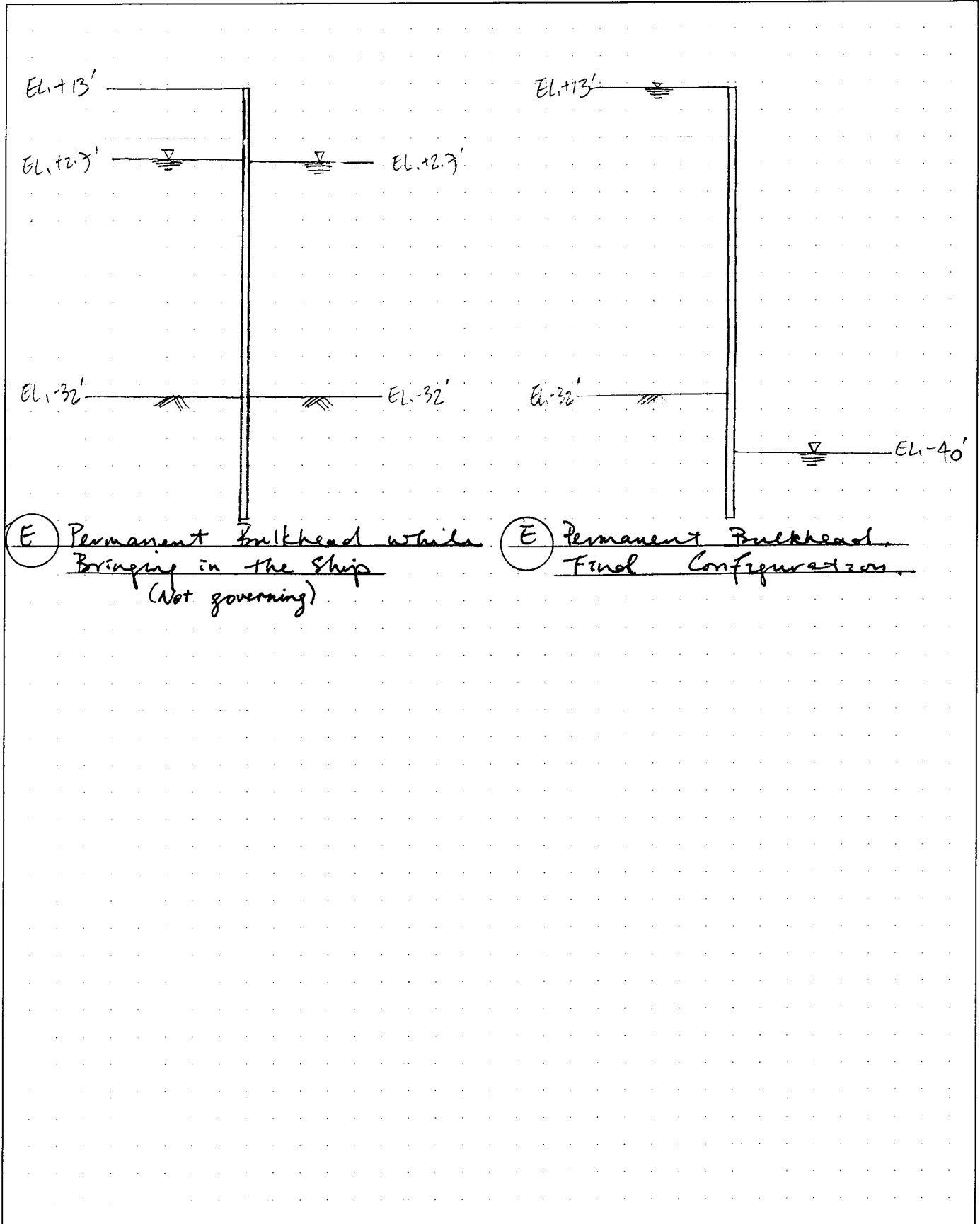


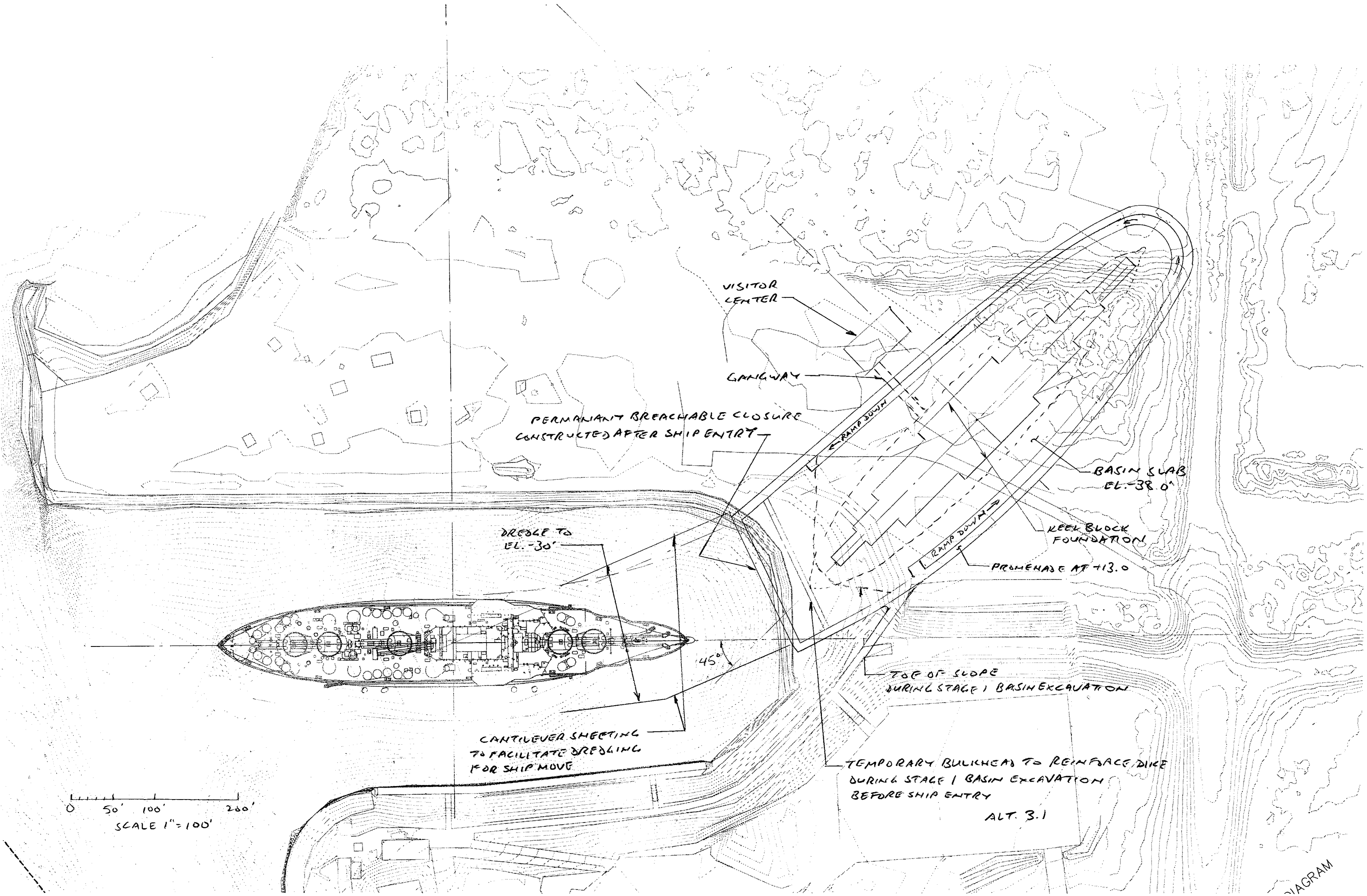
① Sheeting Facilitating Dredging After Dredging



① Sheeting Facilitating Dredging After Dredging

JOB TITLE USS Texas Battle ship (W3.0)  
 JOB NO. 60188085 CALCULATION NO. \_\_\_\_\_  
 ORIGINATOR IK DATE \_\_\_\_\_  
 REVIEWER \_\_\_\_\_ DATE \_\_\_\_\_  
 SCALE \_\_\_\_\_ SHEET NO. 4 OF \_\_\_\_\_





VISITOR  
CENTER

GANTRY

PERMANENT BREACHABLE CLOSURE  
CONSTRUCTED AFTER SHIP ENTRY

DREDGE TO  
EL. -30'

BASIN SLAB  
EL. -38.0'

KEEL BLOCK  
FOUNDATION

PROMENADE AT +13.0

45°

CANTILEVER SHEETING  
TO FACILITATE DREDGING  
FOR SHIP MOVE

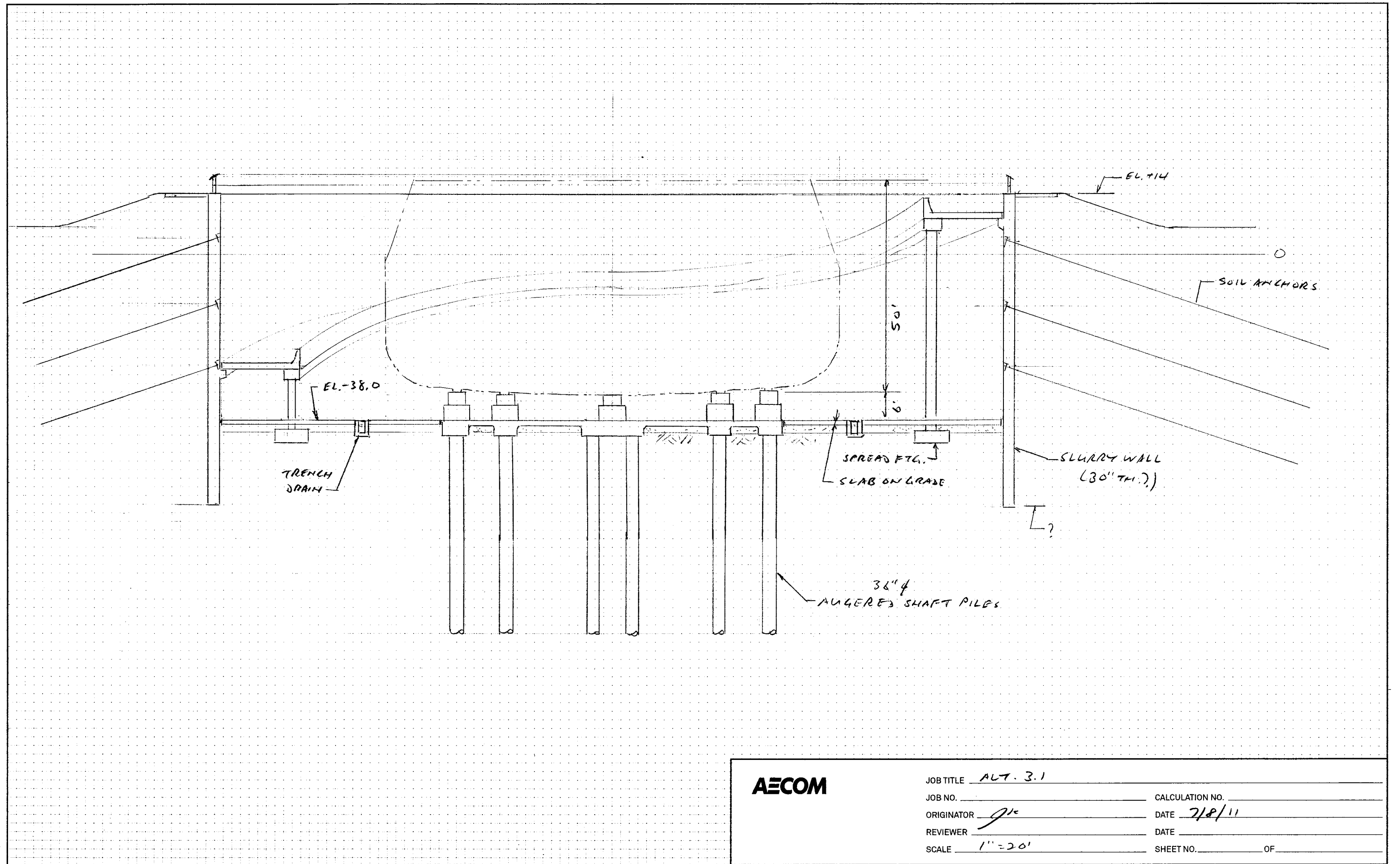
TOP OF SLOPE  
DURING STAGE 1 BASIN EXCAVATION

TEMPORARY BULKHEADS TO REINFORCE DIKE  
DURING STAGE 1 BASIN EXCAVATION  
BEFORE SHIP ENTRY

ALT. 3.1

0 50' 100' 200'  
SCALE 1"=100'

DIAGRAM



**AECOM**

JOB TITLE ALT. 3.1

JOB NO. \_\_\_\_\_

ORIGINATOR gk

REVIEWER \_\_\_\_\_

SCALE 1" = 20'

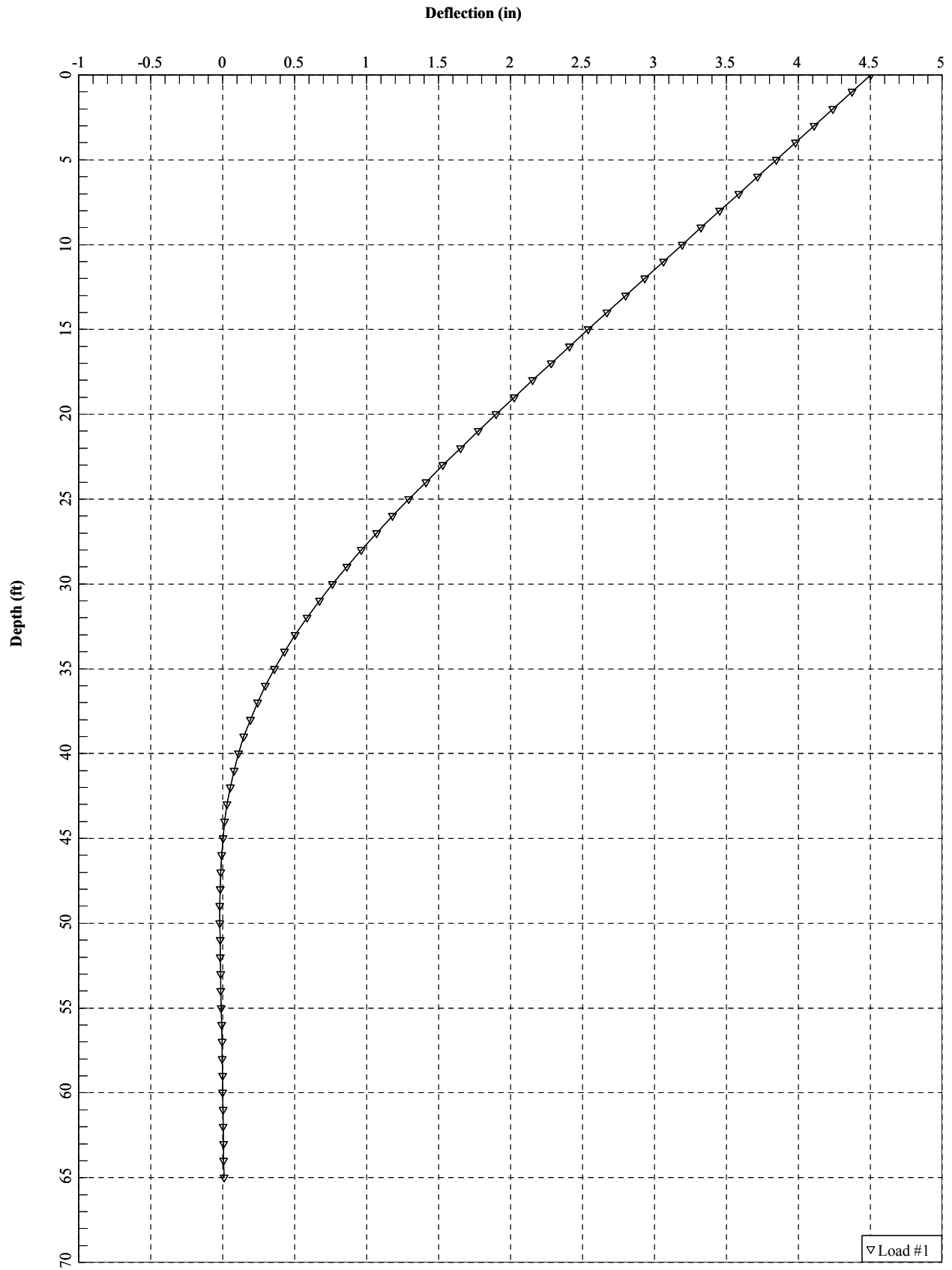
CALCULATION NO. \_\_\_\_\_

DATE 7/8/11

DATE \_\_\_\_\_

SHEET NO. \_\_\_\_\_ OF \_\_\_\_\_

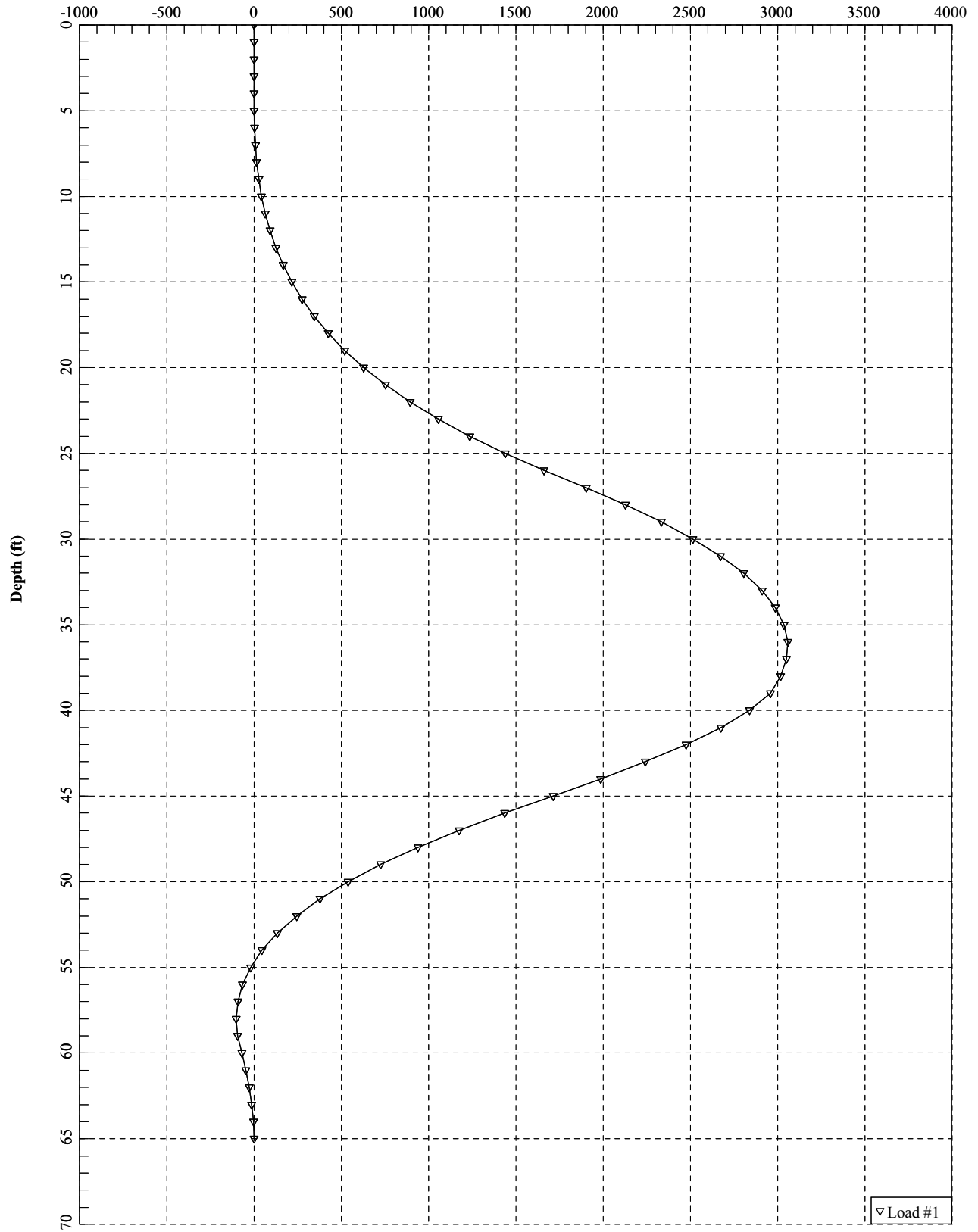
**Battleship Texas, Alt. 3.0, Section A, After Dewatering**



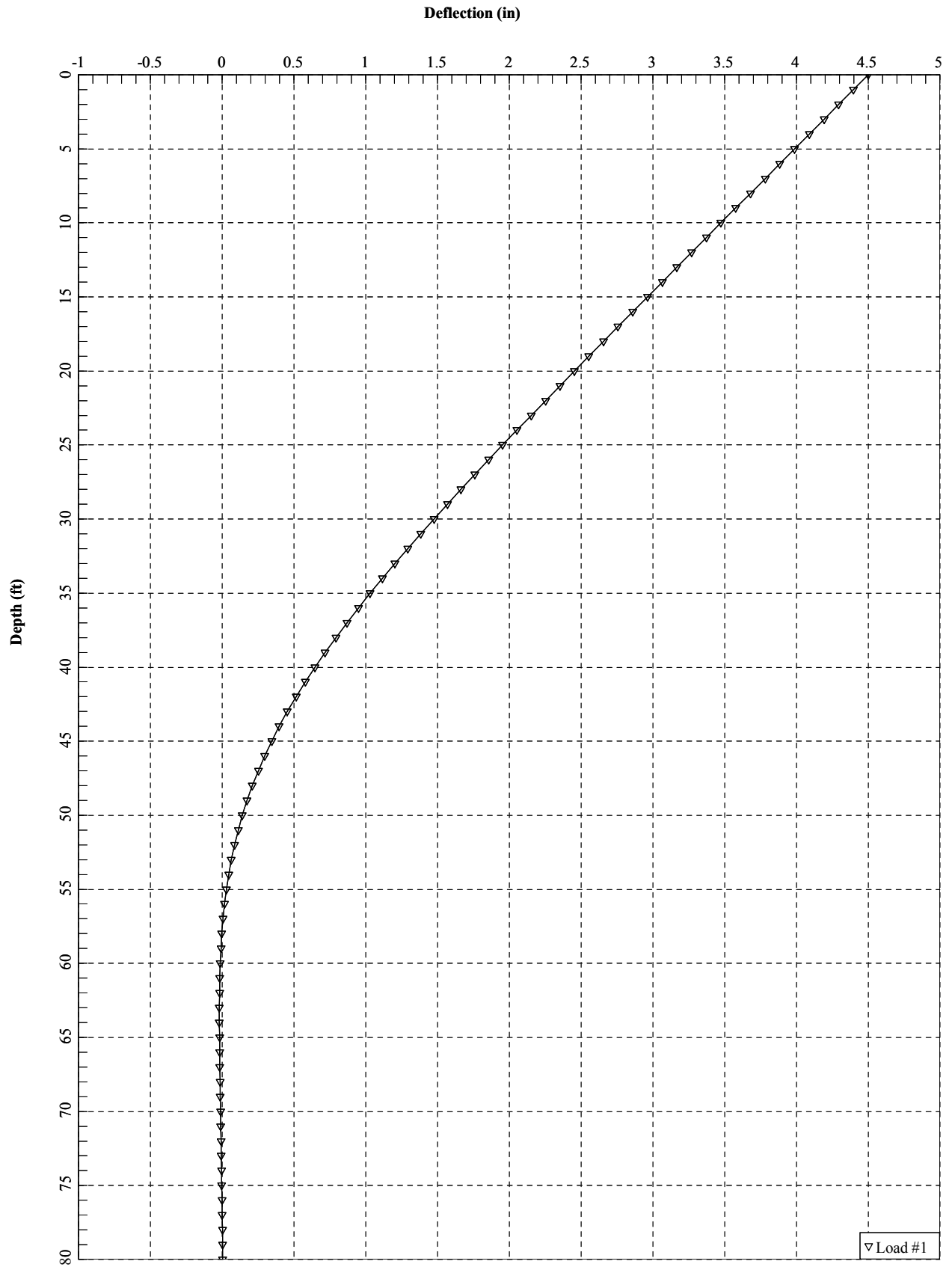


**Battleship Texas, Alt. 3.0, Section A, After Dewatering**

**Bending Moment (in-kips)**

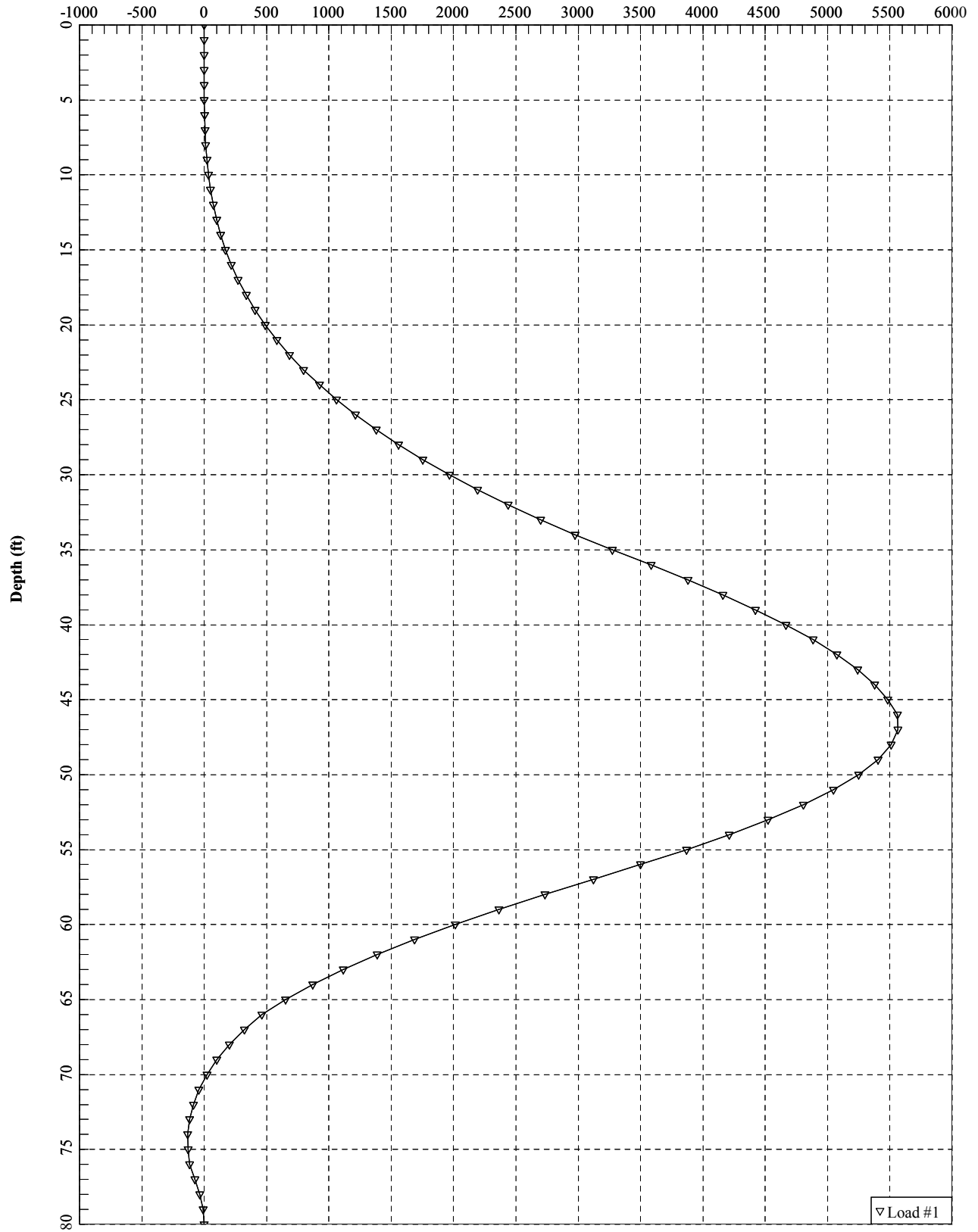


**Battleship Texas, Alt. 3.0, Section D, After Dredging**

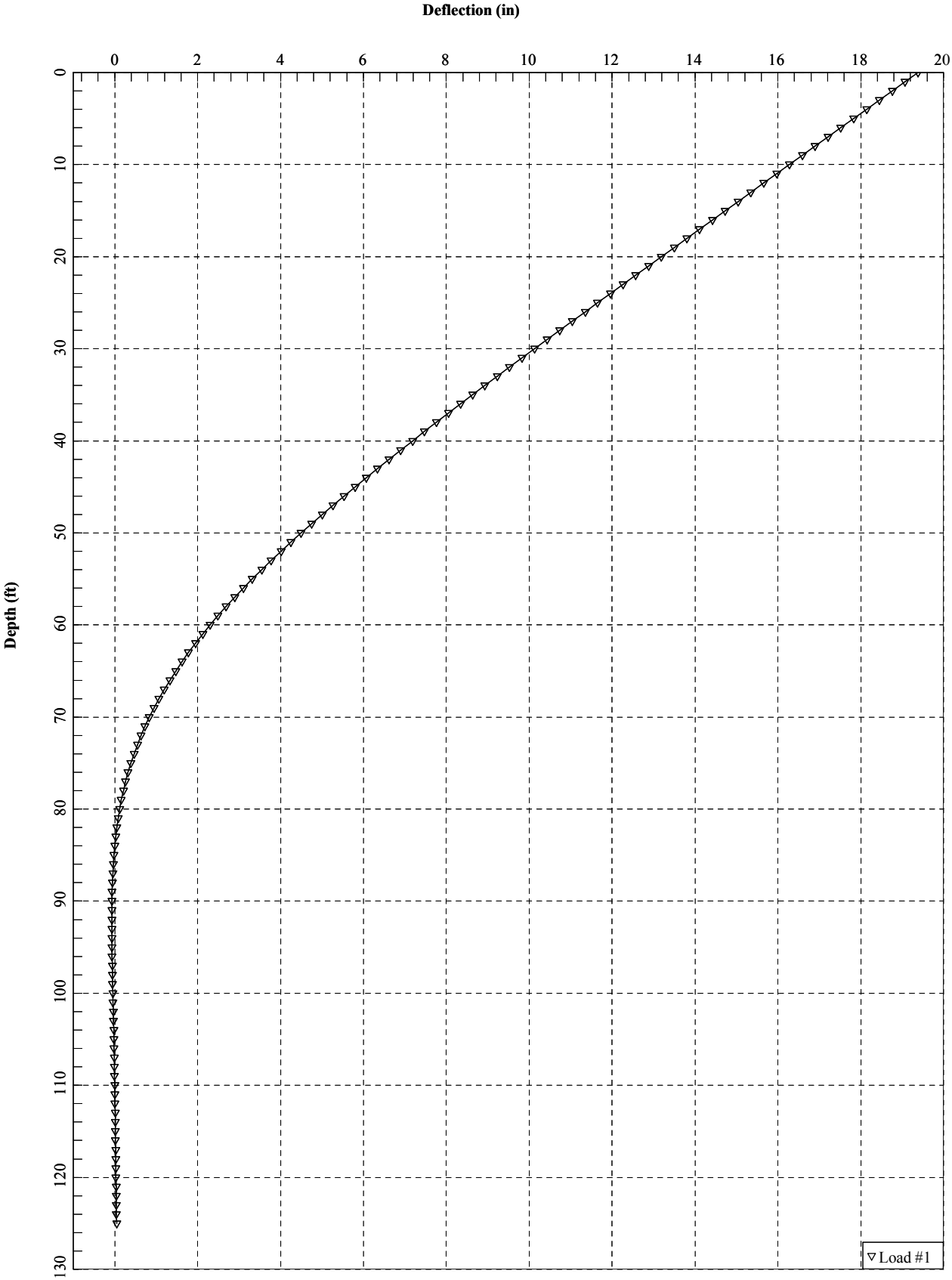


**Battleship Texas, Alt. 3.0, Section D, After Dredging**

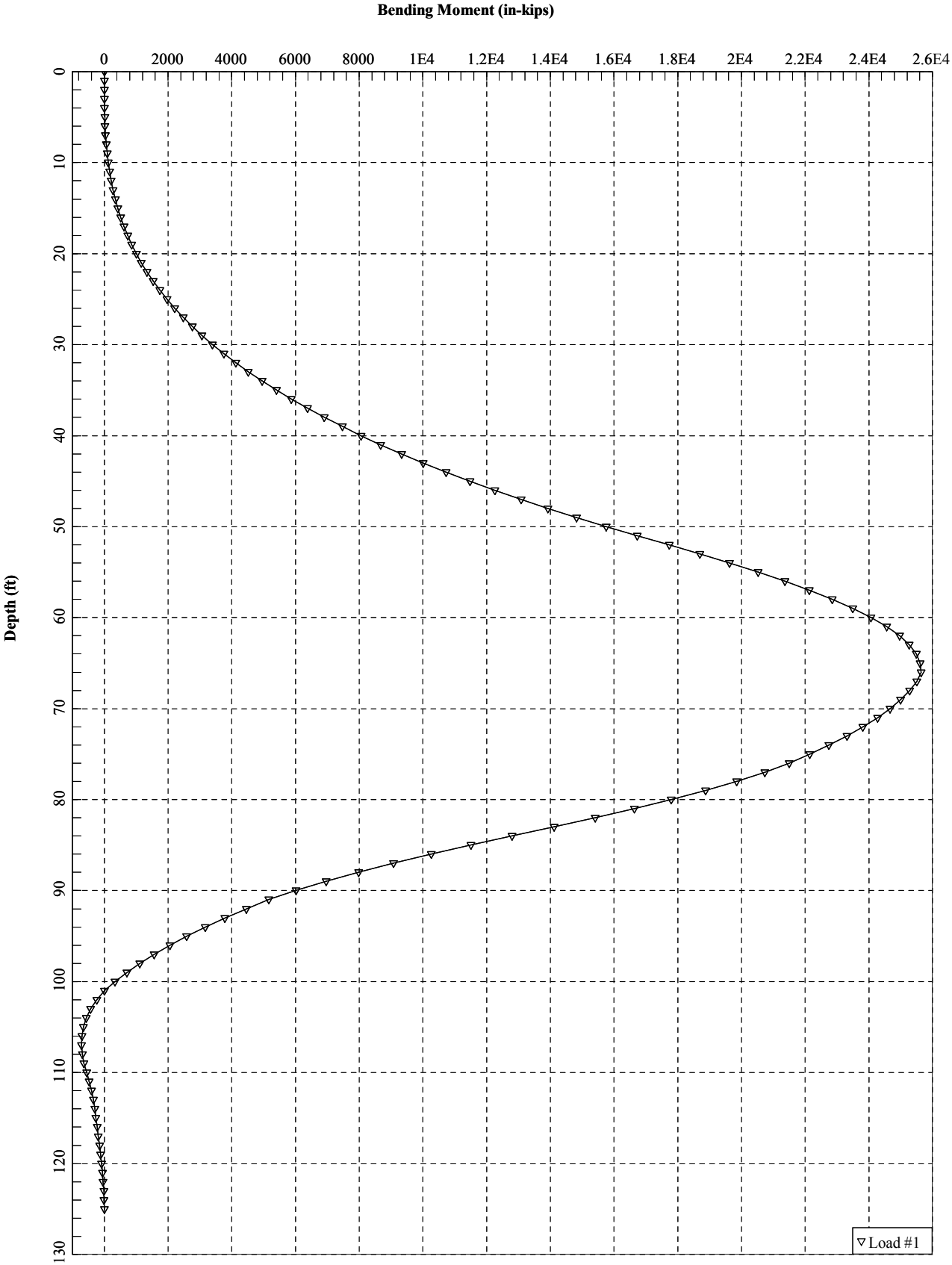
**Bending Moment (in-kips)**



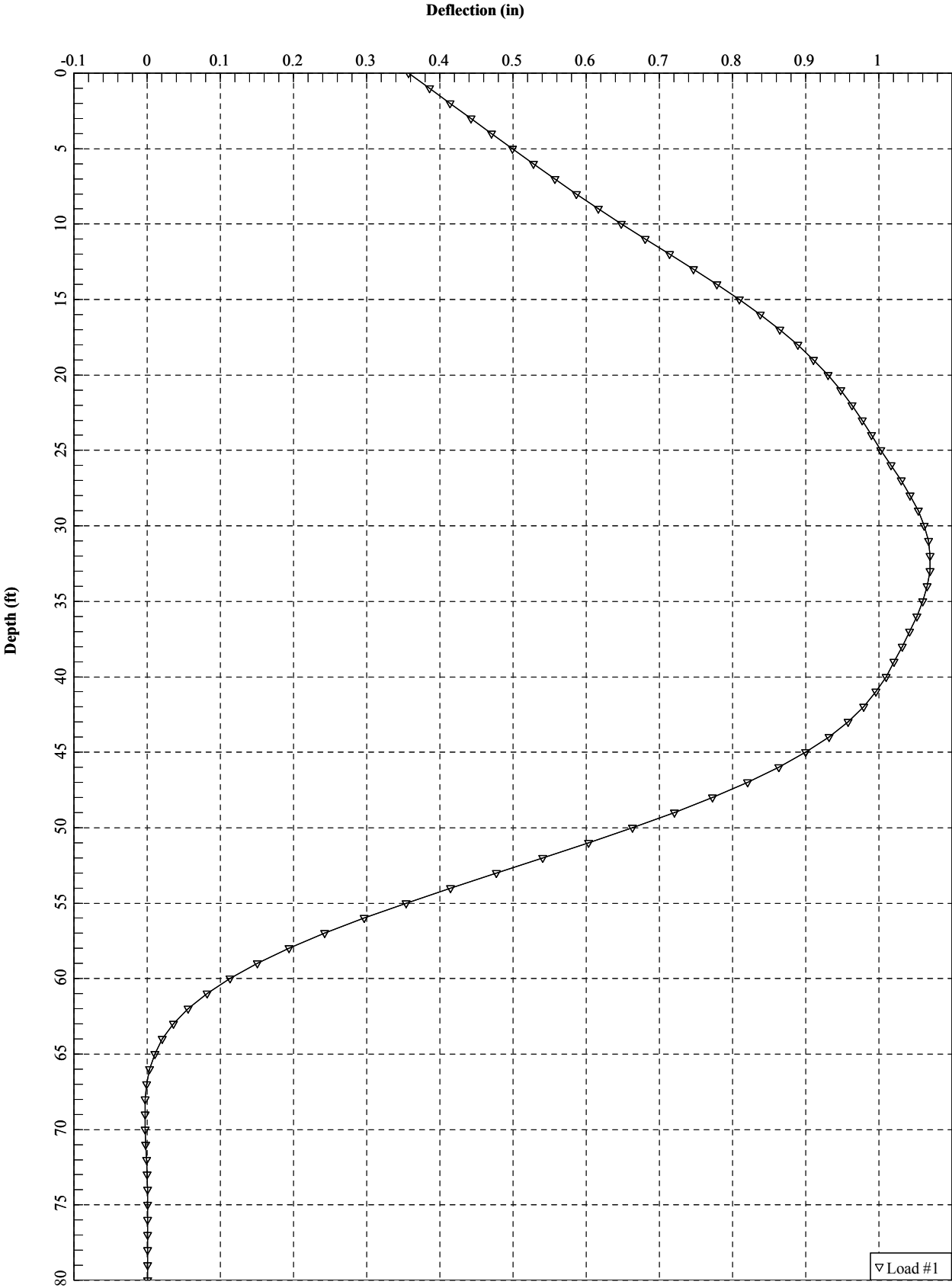
Battleship Texas, Alt. 3.0, Section E, Final Configuration



Battleship Texas, Alt. 3.0, Section E, Final Configuration

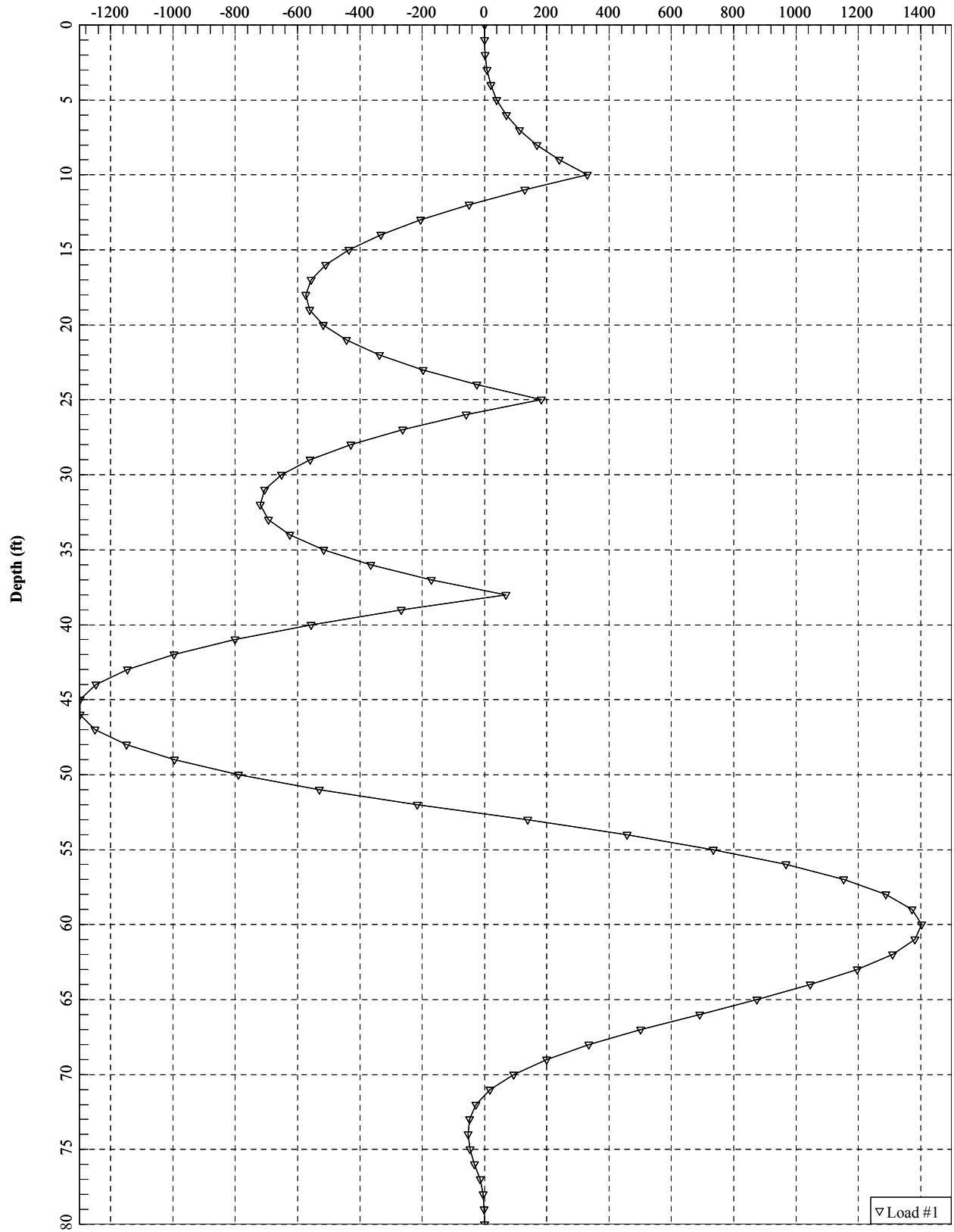


Battleship Texas, Alt. 3.0, Slurry Wall, Final Configuration



# Battleship Texas, Alt. 3.0 Slurry Wall, Final Configuration

Bending Moment (in-kips)



# Battleship Texas, Alt. 3.0, Slurry Wall, Final Configuration

